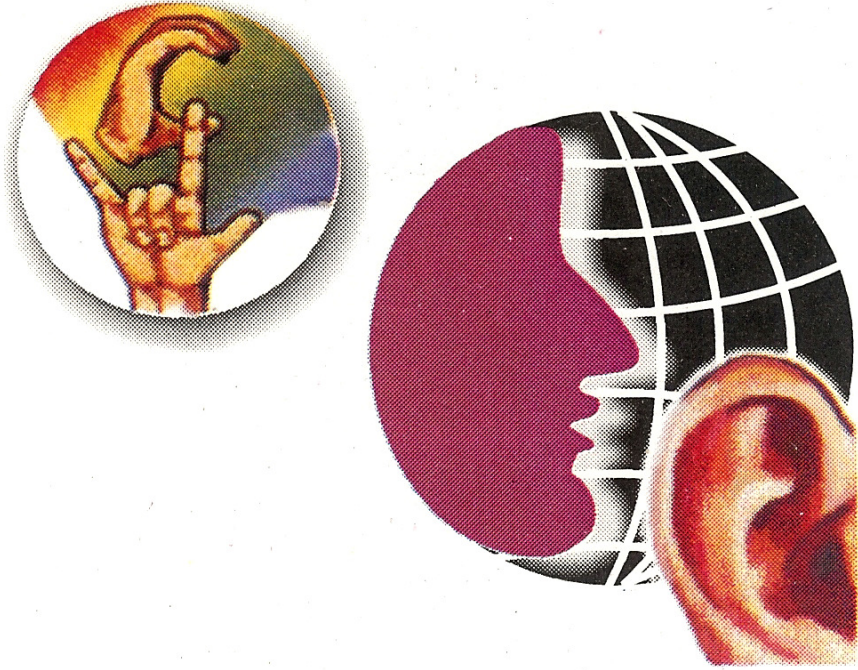


SPEECH OF THE HEARING IMPAIRED



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Speech of the Hearing Impaired

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SPEECH OF THE HEARING IMPAIRED

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S.G. GAYATHRI**



**Central Institute of Indian Languages,
Manasagangotri, Mysore**

Central Institute of Indian Languages

For

**Dr. N. RATHNA
OUR MENTOR, TEACHER,
AND DOYEN OF INDIAN
SPEECH
AND HEARING SCIENTISTS**

FOREWORD

The Central Institute of Indian Languages was established at Mysore on 17th July 1969 with a primary objective of fulfilling the Government of India's resolution that envisaged a set of concrete measures for the development of the major languages of India. The Institute is also charged with the responsibility of conducting research on all the minor and lesser-known as well as endangered languages of India to bring out grammars, dictionaries, style manuals, standardized writing and spelling patterns, language pedagogy materials and language technology tools for such languages.

In order to implement the Institute's goal of developing the major Indian Languages and bring them into our teaching and research scheme – mainly meant for the school teachers, the Institute has set up seven Regional Language Centres in the various linguistic regions of the country to help and meet the demand for trained teachers. This was thought in order to implement the three language formula and the assurances given to linguistic minorities. These centres are charged with the responsibility of developing need based materials and methods of teaching Indian languages as second/foreign languages, train secondary school teachers in languages other than their mother tongues with a view to providing more language choice to young students in secondary schools. It is expected that it would enhance the awareness of the diversity which goes into the building of the mosaic of Indian Culture through their activities such as inter language translations and original writing in an another language, etc.

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With love and admiration, we dedicate this book to Dr. N. Rathna, our mentor, teacher and doyen of Indian speech and hearing scientists.

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Apart from the goals mentioned above the Institute is also charged with the preparation of Instructional materials for the hearing impaired children and also to give guidance to other organizations which are involved in doing extensive research in language acquisition, study of language with its Psycho-social relationship etc.

This book, *Speech of the Hearing Impaired*, by Dr.M.S.Thirumalai and Ms.S.G.Gayathri describes in detail the holistic characteristic features of the speech of a hearing impaired with special reference to Indian context. Also, this book discusses in detail the aspects of auditory perception, multisensory of speech reception in the hearing impaired. One of the special merits of this book is that it vividly describes the effective ways to collect speech samples from the hearing impaired and how a linguist as well as the speech pathologist can handle the collected data for error rectification among the hearing impaired.

Since this book is a pioneering work in the areas of Linguistics and Speech Sciences with reference to Indian context, scholars, teachers and students who are working in these disciplines can be immensely benefited with this book.

Udaya Narayana Singh

Director

23rd July 2004

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CHAPTER - I

SPEECH RECEPTION IN THE HEARING IMPAIRED

1.1 Introduction

This short monograph is the result of a project undertaken by the authors on the speech and language characteristics of the hearing impaired population with Kannada as the environmental language. The research project was undertaken for two years from April 1981 to April 1983. Two main types of hearing impairments were focused in our research. The subjects of the study, who were eleven in number, fell under the categories of moderately and profoundly hearing impaired. Data from these hearing impaired subjects was collected based on a language evaluation tool prepared specially for the purpose by the authors. The language evaluation tool consisted of the following sections:

Personal data which gave the name, age, sex, religion, place of birth, present address, mother tongue, and other languages known, educational level and occupation of the subjects. Section-1 focused on the history of the problem, Section-2 on the audiological evaluation, Section-3 therapeutic history, Section-4 home background, Section-5 educational history, Section-6 psychological history, Section--7 language, Sections-8 and 9 occupational history and other relevant aspects. These sections were followed by a discrimination test in which separate sub-sections on production of individual sounds, discrimination of individual sounds, discrimination of words, imitation of individual sounds and imitation of words,

sentence types and phrases were included. There was also a comprehension test in which lexical recognition was the focus. Commands were given to the subjects, and their ability to follow these command was tested. There was a separate section of conversation in which the subject's responses to questions put to the subjects were collected. There were certain grammatical factors that were focused upto both for production and comprehension. These included pos-positions and plural markers. The voice qualities of the speech in terms of the rate of speech, intelligibility, rhythm and intonation were also looked into. The evaluation tool and authors used in this project, is presented as Appendix-1.

This monograph restricts itself to the presentation of the salient findings of the project as regards the speech characteristics of the hearing impaired. We have organized this monograph in such a way that it will be found highly useful for students of linguistics and adjacent sciences to know something more about the speech characteristics of the hearing impaired even as it presents the salient findings of our research project. The monograph consists of three chapters. In Chapter-1, we present the general characteristics of the manner in which speech is received, characteristics of auditory speech perception in the hearing impaired, perceptual aspects of acoustic cues as found in the hearing impaired, characteristics of visual, tactual speech reception and characteristics of speech reception through audition and vision, and speech reception through vision and tactual modalities. Chapter-2 presents the characteristics of the early linguistic behaviour in the hearing impaired. Focus is on the vocalization, babbling characteristics and the nature of prelingual deafness. In Chapter-3, we present the speech characteristics of the hearing impaired. Methods of collection and analysis of speech samples of the hearing impaired, errors of segmental and supra-segmental sounds, are dealt with. Speech characteristics of the hearing impaired as revealed through instrumental analysis are also dealt with. The authors are very well aware that much needs

to the done in identifying speech production, reception and perception characteristics of the hearing impaired population with Indian languages as environmental languages. In this monograph we have made some attempt to interpret speech and language characteristics of an Indian language as found used in the hearing impaired population. This must be treated only as a preliminary report.

1.2 Speech Reception

Speech reception is generally a pre-requisite for speech comprehension, which, in turn, is a requirement for normal speech and language production. Generally speaking, speech comprehension precedes speech production in the process of first language acquisition, even though certain structures may be produced before they are fully comprehended.

Perception of speech is noticeable in children, in some manner, very early, say, at six months. From the absence of speech perception ability in the early months, the child progresses towards the adult level of speech perception ability in the early months, the child progresses towards the adult level of speech perception ability as his age increases. From early reflexive perception of perceiving one's own sounds, the child begins to acquire perceptual skills of attending to and localizing the sounds emitted by other sources. While one cannot suggest easily a programmatic step by step sound reception from early reflexive perception of one's own sounds to early attending abilities to other sounds, the categories of reflexiveness, early attending, regular attending and localizing the sounds as categories that dominate the sound perception in babies can be easily attested. It is also noticed that hearing levels continue to improve though ages of normal children. For example, hearing levels were found to be better at eleven years than at seven for normal children (Richardson, et al., 1976). Also there is a qualitative difference between auditory processing in adults and animals, since auditory processing in humans are conditioned and shaped by factors that the both

part of specific human physiology and anatomy of hearing mechanisms and human social processes. In a way the auditory processing in young children, rather babies, may be partly compared with the auditory processing in animals. But even here the comparison, in certain ways, may not be appropriate as the relationship between the appearance of cochlear microphonic potential and the onset of auditory function is not identical. Also the first steps of auditory development begin prior to the postnatal period in the human child, whereas the other species are at variance with one another in this regard. The normal child takes nearly nine to twelve months to start his expressive language.

Communicative behaviour in later life is closely linked with auditory competence in early life. With the absence of hearing, or the presence of distorted hearing in the hearing impaired child, the speech perception of the child is also distorted. As a result, the expressive aspect of speech and language of the child is distorted. With hearing impairment, the children have problems with short-term memory (Manning, et al., 1977). Child has difficulty in acquiring language efficiently and in an appropriate manner for successful communication. Auditory deprivation from birth leads to higher level processing problems, both linguistic and psychological. Word order difficulties, difficulties with discrimination of phonemes, delayed and deviant phonological development are some of the problems that are readily attested. The deaf speech has a temporal form distinct from the speech of the normal hearing. Also note that the deaf children do not develop the same hemispheric specialization for language processing just as normal hearing children do.

In order to compensate for his inability to accurately perceive speech through the ears, the child supplements the use of vision along with audition, or uses vision alone as the primary modality for speech reception. Thus, both the motor movement patterns and acoustic patterns made by the speaker during speech production are utilized by the hearing impaired

child for speech perception. Normal hearing children differ from one another in several ways with regard to the frequency of use of vision independent of audition and in aid of audition; there is also difference noticed in the functions of audition and vision in communicative acts between the two. The quality of audition and vision, and of the dependence on vision for audition are some other factors that distinguish the two.

Before we proceed further, it is necessary to characterize the process of perception in general and speech perception in particular. Perception refers to the process by which an individual organizes and interprets sensory data he has received on the basis of his past experience; it is an act of categorization, according to which stimuli are received, identified, sorted and given individual meaning (Eisenson, 1972). The term **speech perception** refers to the process by which the motor/acoustic patterns of speech become linguistic structures in the listener's mind (Boothroyd, 1978). Auditory discrimination is an integral part of auditory processing. Auditory discrimination includes abilities to contrast sounds in the environment as well as the sounds and their patterns in language. By auditory discrimination, we mean an ability to discriminate between the sounds at the articulatory, acoustic and other cognitive levels.

Speech perception begins with the recognition that what is heard is speech and not noise. This recognition is based on the recognition that what is heard is patterned, that what is heard is uttered in a communicative environment, and that what is heard is a specific language (based generally on the comprehension possibilities), and that what is heard is addressed to someone (facial expressions, face to face communication, physical direction of speech, etc.).

Usually, the hearing impaired use audition and vision as primary modalities for speech perception. Attempts are made also to help perceive speech through tactition, in addition. Note that a combination of all the three modalities is easily recognized in the speech perception processes of the normals.

There is, however, a subtle difference between the speech perception in the normals and the hearing impaired. In the normals a dominant role is assigned to audition in speech perception, whereas such a dominance of audition is affected in several ways in the hearing impaired. The complementary nature of the participating three modalities in normals is different from the same found in the hearing impaired.

1.3 Auditory Speech Perception

Broadly speaking, one could identify two types of approaches to the study of speech perception, namely, the motor theory of speech perception and the auditory theory of speech perception. The current research on the role of motor movements in perception, especially of speech perception, indicates that a child perceives sound sequences in terms of his own motor reactions. This motor theory of perception does not deny the importance of the acoustic events, but gives priority to the motor kinesthetic feedback loops in the comprehension and use of language. The perception of speech sounds is seen more closely related to the articulation than to the acoustic stimulus. Speech is perceived by the articulatory movements and their sensory effects mediate between the acoustic stimulus and its perception. The articulatory movements that a listener makes in reproducing the acoustic patterns help in determining the cues for perception of words. Linguists like Twaddell (1952) also are of the opinion that listeners classify sound sequences on the basis of motor articulation rather than acoustic properties. Further some psychologists like Cherry (1957) suggest that if there is an order in acoustic and articulatory have been mediated. The problem of the hearing impaired, in this school, then, is seen related not to the problem of the hearing impaired, in this school, then, is seen related not to the problem faced by the deaf in correctly perceiving the acoustic values of the sounds produced, but the failure on the part of the deaf to relate the acoustic cues to appropriate motor reactions.

The study of auditory perception of speech includes both the physical aspects of sound and the physiological aspects/apparatus for audition. Auditory perception is conditioned by the physical properties of a particular cochlea. If the frequency of the sound received is below or above that which can be perceived by a particular cochlea, there is no question of auditory perception. Hearing means variations in the acoustic intensity. One receives information by variations in the acoustic intensity. This acoustic intensity is converted into a nervous message. When this message is integrated with a structure already available to the individual in his cognitive level, hearing has taken place.

The auditory perception may be imagined to be taking place in several phases. Berry presents three phases in auditory perception of speech, while agreeing at the same time that such identification and segmentation of auditory processes of perception are merely a kind of abstraction for the matching of specific neural activity with the temporal phase. In the first phase, activation of neurons takes place, and this requires a chemical mediator which is responsible for the sensitivity of end organs. Further the change in the end organs should be transformed into a form of energy capable of discharging the nerve terminals. In the second phase, the wave pattern makes connections with various parts of the hearing apparatus. While these connections are being made, modification and discrimination of the auditory patterns continue. At this stage, information from other modalities, particularly from the reticular system, is available for organizing and focusing on the perceptive field of audition. All the systems that are relevant for perception in general pool their resources in arriving at a comprehensive auditory perception of speech and other events. At this phase, short-term memory (use of retained auditory patterns from earlier inputs) is utilized. Analysis by synthesis of various number and kinds of information is the highlight of the auditory perception process in the third phase. In linguistic terms,

ordering and sequencing of syllables, words, phrases and sentences are achieved in this phase.

Findings in the study of auditory perception more or less dominate approaches to the study of speech perception by the hearing impaired. With advances in the techniques to measure the acoustic qualities, and with the availability of sensitive electronic devices, greater emphasis is now laid upon the study of auditory perception of speech for practical ends. Generally speaking, in the study of auditory speech perception, audiograms, analysis of the acoustic correlates of speech and experiments on speech perception play a very important role.

The acoustic cues for the recognition of speech are sought generally in terms of phonetic discrimination based on underlying acoustic configurations for each of the phonemes and for their combinations. Acoustic cues emanate from the source (breath and voice) and signal (vocal tract) characteristics. The speech process may be viewed as a series of basic changes in the flow patterns (and resultant acoustic characteristics) of the breath stream, and modulations in the form of secondary shifts within and among the frequency, intensity and time parameters of sound. There are four major entities noticed in the formation of acoustic cues. These are the soundless hiatus, periodic sound, frictional noise made when structures along the vocal channel are brought close, and impulse noises made as a result of complete momentary stoppages of the air stream.

The acoustic cues for recognition of the voice of an individual revolve around the fundamental frequency of the voice, its intensity and the voice quality. Since the total range of fundamental frequencies encountered in speech of men, women and children put together extends from 60 Hz to about 500 Hz (Fery, 1973), the hearing impaired child should have hearing in the range of 60 to 500 Hz in order to detect the presence or absence of voice, and to process acoustic cues to perceive sounds and their combinations.

Next come the acoustic cues for the discrimination of consonant and vowels. There are certain differences noticed between vowels and consonants in terms of energy concentration. The distinction between vowels and consonants is generally agreed to the made. So, we may try to identify the acoustic cues for a distinction between the vowels of the language exposed to the hearing impaired. In Kannada, the following values may be identified, as an extrapolation of data provided in Rajapurohit, 1982.

TABLE 1 : Relative duration in milliseconds of vowels in Kannada in the initial, medial and final positions, given in descending order (adapted from Rajapurohit, 1982).

Initial	Medial	Final
o: (196.66)	u: (168.00)	i: (138.16)
ô: (194.00)	a: (157.80)	a: (138.06)
a: (169.50)	e: (151.16)	e (188.85)
u: (150.00)	o: (146.22)	u (84.98)
i: (132.00)	i: (136.41)	i (80.81)
e (114.00)	o (84.00)	a (68.54)
o (98.00)	e (83.16)	
ô (75.14)	a (71.84)	
i (75.00)	ô (64.08)	
a (67.13)	i (60.08)	
u (64.73)	u (58.05)	

TABLE 2 : Relative intensity of Kannada vowels in millimeters in the initial, medial and final positions, given in the descending order (adapted from Rajapurohit, 1982). Note that the intensity is measured in watts or computed in decibels. On the basis of oscillograms, used by Rajapurohit, 1982, neither of the measurements was possible; measurement, here, is offered in terms of the height of the

highest period or peak from the central line,
the positive side, in millimeters.

Initial		Medial		Final	
ð:	(9.5)	e:	(9.5)	i:	(9.0)
o	(9.0)	i	(9.0)	e	(8.5)
e	(8.5)	i:	(8.5)	a:	(8.5)
a	(8.5)	e	(8.5)	i	(7.0)
a:	(8.5)	a:	(8.5)	u	(3.0)
i:	(7.0)	o	(8.0)		
o:	(7.0)	a	(8.0)		
i	(6.0)	u:	(8.0)		
u:	(6.0)	ð	(7.5)		
u	(5.5)	o:	(7.0)		
ð	(5.0)	u	(7.0)		

TABLE 3 : Format frequencies of vowels of Kannada
(adapted from Rajapurohit, 1982).

Vowel	F ₁	F ₂	F ₃
i	280	2200	2800
i:	305	2300	3100
e	400	2000	3500
e:	500	2200	3500
a	750	1500	2500
a:	800	1400	2600
ð	500	1200	2500
ð:	500	1200	2500
o	500	1000	2200
o:	600	1000	2500
u	260	460	1000
u:	300	500	1000

The acoustic cues for individual and combined sounds are described in terms of formats - the resonant bands - as seen in a spectrogram. The range of frequencies are clustered

around a central peak frequency or pole. One each side of the pole, the formant slopes off to zero intensity. It is well known that the formant frequency structure is important for the discrimination between vowels. In isolation, most vowels are identified if both first and second formants are heard (Liberman, Delattre, Cooper and Gerstman, 1954). If F_3 is also heard, it improves the identification of high front vowels. From the formant frequency values obtained for Kannada vowels (based on Rajapurohit, 1982), the following hypotheses can be made.

When we consider only the durational aspects of sounds, we find:

- i) Distinction of length is well established in the initial position among vowels.
- ii) However, there is no contrast between short and long *a* and *e* in the initial position. Only the longer counterpart *e:* is found occurring.
- iii) With a residual hearing of 64 msecs. to 197 msecs., a subject should hear all the Kannada vowels in the initial position.

Thus, as regards the vowels in the initial position, in Kannada, the hearing impaired may be expected to have difficulty with regard to distinguishing length as a significant marker. Since there is no contrast between *e* and *e:* in the initial position (according to the analysis adopted here) the hearing impaired may have difficulty in the perception of the mid vowel *e* or *e:*. If the residual hearing is distorted (that is, if the residual hearing is not within 84 and 197 msecs.), we should expect the hearing impaired to have difficulty with the perception of Kannada vowels may be determined based on the available range of msecs., in the residual hearing of the hearing impaired. It may also be noted that the durational aspects clearly maintain a distinction in msecs., between the group of short vowels and long vowels.

Thus if a subject has a residual hearing upto 76 msecs. (75.14 msecs. of ∂ being the maximum), he is likely to perceive all the short vowels. The vowels lend themselves to be grouped distinctly under separate groups of short and long vowels, but there is the possibility that only some short and long vowels to the exclusion of others are perceived.

A similar pattern emerges as regards the acoustic cues of vowels in the medial position.

- i) Distinction of length is well established in the medial position among the vowels.
- ii) However, there is no contrast between ∂ and $\partial:$. Note only the shorter counterpart ∂ is found occurring.
- iii) With a residual hearing of 58 msecs. to 70 msecs., (168 msecs. of u: being the maximum), a subject should hear all the vowel sounds in the medial position. Distortion in this range reveals some hearing impairment or other, with regard to some vowels.

The durational aspects clearly maintain a distinction between short and long vowels. However, a higher residual hearing is demanded in the medial position (84 msecs. of o being the maximum). But a much lower residual hearing (58-05 msecs. of u would help perceive a speech sound in the medial position in Kannada. In other words, there is difference between the low levels of residual hearing demanded for the perception of Kannada vowel sounds when they occur in the initial and medial position. In general, all the Kannada vowels while occurring in the medial position have lower msecs. of duration in comparison to their occurrence in the initial position. Thus, for the perception of Kannada vowels occurring in the medial position, a subject requires a lower (durational) residual hearing than for the vowels that occur in the initial position.

In the word final position, only a few vowels occur. Two vowels, namely, *e*: and *u*: are not attested. The value for *e*, however, is much higher than the value for *e* in the initial and medial positions, and thus *e* has almost the value of longer vowels, whereas in the case of *u* and *u*: it is the shorter vowel that is attested. In the word final position, contrast between only two vowels (*i/i*: ; *a/a*:) is found. With a residual hearing of 68.54 msecs. to 138.16 msecs., a subject should be able to hear all the vowels that occur in the final position in Kannada. With a residual hearing upto 118.85 msecs. a subject will hear all the short vowels of Kannada that occur in word final position.

In order to hear the F_1 , F_2 and F_3 values, a frequency range of hearing between 260 [F_1 of *u*] to 3500 Hz [F_3 of *e* and *e*:] should be present. With residual hearing upto 2300 Hz, the first two formants of all the vowels can be heard. Residual hearing upto 800 Hz is necessary for F_1 of all vowels to be heard. With similar formant (F_1) values, visual cues should be made use of. For example, *ə*, *e*:, *o* and *e*: all have similar F_1 values (500 Hz). Lip rounding can be visualized for *o* but not for *e*:, *ə*, and *ə*:. *e*: and *ə* and *ə*: differ in terms of tongue positions. Further durational cues help to discriminate between *ə* (75.14 msecs.) and *ə*: (194.00 msecs., if in initial position).

In addition, the vowels vary in intensity. As can be seen from Table-2, there is a range of intensity for vowels in Kannada. *u* is most often the soft vowel while *ə*:, *e*: and *i*: are loud vowels. It can further be seen that the intensity of the vowels varies with respect to their positions in the word. The acoustic cues for the diphthongs depend on the component vowels. Position of occurrence of a vowel or a consonant is of great consequence for the hearing impaired in the correct perception of sounds uttered.

A combination of acoustic cues often serve to discriminate between the consonants. These include the

transductions, invariant energy, variant energy, intensity of the consonants, and their durational variations. For English consonants, Fletcher (1970) has listed these contrasts. In Kannada and other Indian languages, such contrasts are yet to be determined. However, it is possible to hierarchically arrange the consonants in Kannada (in a specified context) with respect to intensity, as can be seen from Table-4 below.

TABLE 4: Relative intensity of Kannada consonants in varied contexts (based on Rajapurohit, 1982).

CV	VCV	C ₁ C ₂		C ₁ # C ₂		C ₁ C ₁	Ch	Aspirati -on
		C ₁	C ₂	C ₁	C ₂			
1	2	3	4	5	6	7	8	9
ṣ(6.0)	y(8.0)	v(8.0)	ś(6.5)	y(7.5)	y(8.0)	l(7.5)	č(5.0)	d(7.0)
č*(6.0)	l(8.0)	l(8.0)	v(6.0)	n(5.0)	l(7.0)	y(7.0)	j(4.0)	d(7.0)
v(6.0)	ṇ(8.0)	y(6.5)	ś(6.0)	l(4.5)	n(6.0)	v(6.0)	---	---
r(4.0)	v(6.0)	ś(6.5)	č(5.0)	ṇ(4.0)	m(5.0)	l(6.0)	---	b(5.0)
n(4.0)	l(6.0)	m(6.0)	l(5.0)	m(3.5)	ṇ(5.0)	n(6.0)	---	č(5.0)
l(3.5)	m(6.0)	ṇ(6.0)	ṇ(5.0)	ṣ(3.0)	č(4.0)	m(6.0)	---	ṣ(4.0)
y(3.0)	ś(5.5)	ṇ(5.0)	y(4.5)	---	ṣ(2.0)	č(5.5)	---	---
j*(2.5)	n(5.5)	l(5.0)	l(4.5)	r(1.0)	r(1.0)	n(5.0)	---	k(3.0)
m(2.5)	ś(5.0)	ś(5.0)	n(4.5)	---	---	ṣ(3.0)	---	g(3.0)
s(2.5)	ṣ*(5.0)	n(3.5)	r(4.0)	---	---	---	---	p(3.0)
h(0.5)	č*(4.5)	č(3.5)	m(3.0)	---	---	---	---	t(2.0)
---	s(2.5)	ṣ(3.0)	s(3.0)	---	---	---	---	t(1.5)
---	h(2.0)	s(3.0)	ṣ(3.0)	---	---	---	---	---
---	r(1.0)	h(3.0)	---	---	---	---	---	---
---	---	r(1.5)	---	---	---	---	---	---

* Affricate

In the CV consonant ṣ is the loudest consonant and h is the softest. In the VCV context y is the loudest and r is the

softest. In the $C_1 C_2$ context v and ʃ are the loudest, and r and ɹ are the softest consonants. In the $C_1 \# C_2$ context, y the loudest and ɹ and r are the softest. In the $C_1 C_1$ context ɹ is the loudest and ɹ is the softest. In the Ch context ʃ is the loudest and ɹ is the softest, whereas among the fully aspirated sounds d is the loudest and t is the softest. Note that non-stop and non-nasal consonant sounds are the loudest in Kannada, and note also that the same non-stop and non-nasal consonant sounds are also the softest.

In general, the following comments may be offered. The peak of noise energy for the noise burst in the plosive is located between 600 to 800 Hz for labials; for the velars in the region of 1800 to 2000 Hz and for the alveolars at about 4000 Hz. All these values are for English consonants. As regards the fricatives the noise energy is generally between 1800 to 2000 Hz to about 6000 Hz and beyond for some of the fricatives. Many severely hearing impaired children find all the fricative noises inaudible. The spectrograms of the affricates are essentially the same as those of a stop followed by a fricative. The cue associated with the nasal consonants include low frequency formant between 250 to 300 Hz. The nasals are seldom confused by the hearing impaired, because both variant and invariant cues associated with the nasal consonants are present in the low frequency range. The acoustic characteristics of the glides are also described in context with the following vowels. Independent status of glides and semi-vowels is to be decided in conjunction with their status as independent graphemes in the script. At the spoken level, the appropriate use and recognition of glides is mainly a sociolinguistic device. For sheer conveyance of information, the glides do not seem to play a role.

The acoustic characteristics of the consonants were reviewed so far. The listener, by paying attention to selected acoustic features of consonants, discriminates between the consonants. Some of these features are available to the hearing

impaired and some are not. In any case, the availability of these sounds are ultimately dependent on the residual hearing.

By bearing in mind the frequency range of the sounds of the language of the hearing impaired, one can grossly arrive at the features accessible to a particular child. In this, audiometric tests help us decide the residual hearing levels in the hearing impaired subjects, even as they point out to the various norms of adequacy of hearing for speech in the normal hearing subjects. Audiometry helps locate the hearing impairment conditions in relation to middle, outer and inner ear, cochlea, and auditory neural pathway. Audiogram also plays a useful role, although the usefulness of audiogram for correctly characterizing speech perception is limited. Note that, while an audiogram plots the frequency and intensity of the detection of tones, the speech itself and the processes of speech perception are of a complex phenomenon with rapidly changing acoustic stimulus. Note, however, that in the absence of elaborate description of acoustic cues for Indian languages, such as the one found in Fletcher (1970) for English, the audiologists are forced to interpret the audiograms based on findings on European languages only.

In so far as Kannada and other major Indian languages are concerned, the following acoustic values have to be identified: vowels as opposed to consonants; within vowels opposition between long and short vowels; rounded and unrounded vowels; high, mid and low vowels; within consonants, stops (voiceless, voiced, aspirated and unaspirated), affricates, nasals, fricatives, laterals and trills. The consonants are to be viewed in terms of bilabial, labiodental, dental, alveolar, retroflex, palatal, velar, glottal and uvular sounds. As there are some major tonal languages, the investigation of the tones is also necessary. By working out frequencies of each of the significant or units in the normal hearing population and comparing the same with the perception values of the hearing impaired, an acoustic picture of the hearing impaired can be acquired.

This picture, however, is inadequate for at least two reasons. One reason is that only frequency ranges for individual sounds and not their combinations, as in actual speech would be available. Secondly, even if certain frequencies are available, it may be that the configurations of these frequencies made by the hearing impaired may be different from those of the normal language. And yet interpreting the audiogram, etc., on the basis of acoustic values identified for the sounds of the normal language of the hearing impaired would be a good beginning step.

Ling (1976) and others have specified the residual hearing essential to determine various auditory stimulus categories. The idea is to identify the essential residual hearing for specific sounds in acoustic measurements, and compare this with the residual hearing available to a hearing impaired individual. Once the residual hearing of a hearing impaired person is measured in acoustic terms, it is assumed that, generally speaking, the sounds that fall within this residual hearing are available to the hearing impaired individual. Describing the auditory speech reception in the hearing impaired, Ling (1976) suggests that plosives (of English) are audible to children with only low frequency residual hearing. Likewise if a child has only low frequency residual hearing, he is able to hear the stops. Also the nasals in English, he finds, require low frequency residual hearing. However, if the child does not hear higher frequencies, then the nasals are not identified and discriminated among them and other consonants. For example, discrimination between m and n becomes possible only with hearing upto 1000 Hz. As regards semi-vowels, low frequency residual hearing is sufficient. On the other hand, liquids are less likely to be audible to children with only low frequency residual hearing. Fricatives are more often inaudible to many hearing impaired children. The sibilants s and z are likely to be audible only if hearing extends upto and beyond 3000 Hz. With hearing only upto 3000 Hz, the presence of the fricative is determined in the

context of back and central vowels. Amplification beyond 3500 Hz facilitates their reception. However, affricates require hearing upto 1000 Hz only.

The voiced-voiceless distinction varies from consonant category to consonant category. For example, the voiced-voiceless distinction in plosives is easy to achieve with residual hearing present below 500 Hz, whereas the distinction is achieved in the fricatives if hearing extends beyond 500 Hz. Both manner and place of articulation distinctions are all available with hearing upto 4000 Hz, whereas with hearing upto 1000 Hz the manner of articulation as regards fricatives, affricates and plosives is not available. If hearing extends only upto 2000 Hz, the place of articulation of a consonant sound is to be perceived in the context of central and back vowels. If hearing is below 1000 Hz the place of articulation of a consonant sound is to be generally perceived with back vowels. Note also that voicing reception varies from one group of sounds to another group of sounds. That is, reception of voice differs based on the manner by which a group of sounds is produced. Also reception of one and the same sound varies in terms of its position in relation to the vowels around. For example, if hearing extends only upto 2000 Hz, many a cue not available in the context of front vowels is possible in the context of central and back vowels.

As regards the place of articulation, those hearing impaired children with residual hearing upto 4000 Hz will have relatively complete information on place of articulation (Ling, 1976). The vowel environment may also influence the cues for place of articulation. Many cues on place of articulation which are unavailable in the context of front vowels if hearing extends to only 2000 Hz, are audible in the context of back and central vowels. In the same way, many more cues on place of production are available below 1000 Hz in the context of back vowels rather than in front vowels. Only one unambiguous cue is available under 500 Hz, namely, the

burst associated with the bilabial plosives in a back vowel context.

Ling (1978) has worked out a five sound text. The ability to detect all these five speech sounds, u, a, i, s and ʃ for him, demonstrates the ability to detect all aspects of speech sounds (in English). While this list is, indeed, highly useful for hearing aid selection and also to check the hearing aid itself, one should bear in mind that speech perception is not solely acoustic values-bound. Secondly, it is possible that, at least in so far as Indian languages are concerned, some more crucial additions such as length of vowels, aspiration and retroflexion be also included within this range.

There are several questions such as the following to be raised and answered before one arrives at a comprehensive list of sensitive acoustic indices for each language: To what extent the reception of sounds in the hearing impaired is affected also by cultural facts, particularly in the partially moderately deaf of all ages; to what extent the perception of speech sounds is affected also by patterns of distribution of sounds in a specific language; what is the nature of the inability even among the normal hearing to discriminate between sounds in a language; free variation of sounds; ability to discriminate but inability to produce some sounds; ability to produce but inability to perceive some sounds, dialectal influences and the prevalent norm and fashion in the production and perception of sounds and so on. Even as we look into perception based only on motor and/or auditory perception of sounds, we have to look for application of these findings for higher levels of language. For example, word recognition involves more than recognition of stretches of sensations with hiatus. We found in our study that the profoundly deaf subjects were able to produce a semblance of intonation patterns, particularly at the end of an utterance, but this in no way improved the number of words recognized and used by them. While we found it possible to make the profoundly deaf subject recognize some selected sounds, it was not possible for us to help them increase the

number of words they recognized and used. In other words, the study of speech perception of the hearing impaired has to be based not only on the acoustic values but also on the other factors, both linguistic and those specific to hearing impairment as a process. Note also that the hypothesis that the relative perceptual salience of certain aspects of the acoustic signal can be predicted by their relative acoustic energy is doubted in several quarters (Goldstein, et al. 1976). All these, however, do not diminish, in any manner, the immense practical value of the approaches to the speech perception of the deaf based on acoustic studies. They only point out the need to supplement the results of these studies.

1.4. Perceptual Aspects of Acoustic Cues

The acoustic analysis of speech sounds helps us in understanding the probable difficulty associated with a specified type of hearing loss. However, in order to arrive at a comprehensive picture of the hearing loss, the perceptual experiments on acoustic cues, utilizing the hearing impaired subjects are also important. The results of such perceptual experiments give us an idea of how acoustic cues are perceived. The results help us also to develop better methods of auditory training for the hearing impaired and to develop suitable aids for them. Such studies help us also to understand better the relationship between auditory experience and speech production.

The perceptual experiments on acoustic cues have used both natural and synthetic speech as their domains of research. The hearing loss is superimposed in normal hearing subjects through masking of noise and through the filtering of speech. These experiments have focused on the various acoustic features of vowels, consonants and prosodic features and various components of the acoustic features. The band widths, frequencies, intensities, formants and so on have been interfered with in these experiments to find out the indispensable values in each of the above for a correct

perception of a particular sound. The relationship between the place of articulation and the manner of articulation in perception is also investigated. The perceptual hierarchies between various places of articulation, and the perceptual hierarchies between various types of manner of articulation are also studied.

We present below some of the salient findings of the perceptual experiments on acoustic cues which are generally accepted in the field. These findings are based on experiments which used the linguistic variables of the English language. Perceptual studies on acoustic cues utilizing linguistic variables of Indian languages are not available to the authors.

- 1) The phonetic features used by deaf listeners to perceive and discriminate speech sounds are the same as those used by normal list listeners.
- 2) Voicing and the nasality are much less affected by masking noise than are the other features.
- 3) Under all conditions, features of place of articulation of the consonants are more poorly discriminated than the voicing and manner features.
- 4) The features of place of articulation are found more difficult to be perceived. Note that perceived manner is seen to affect perceived place. The processing of the place feature depends upon the value the listener assigns to the manner features, rather than directly on any acoustic cues to manner.
- 5) The voicing features are discriminated better than the manner features.
- 6) For the consonants, the place of articulation was poorly perceived by the hearing impaired sensorineural listeners.

- 7) Initial consonants are perceived better than final consonants by hearing impaired listeners.
- 8) Vowel discrimination is better than consonant discrimination for severely impaired sensory neural listeners.
- 9) The sensorineural listeners among the hearing impaired, in general, discriminate the back vowels better than the front vowels.
- 10) Perceptual experiments of suprasegmentals in hearing impaired listeners are not available to the authors. However, the presence of hearing in the range of 100 Hz to 500 Hz is said to be sufficient to perceive the intonation patterns (Ling, 1976). The range is said to encompass the hearing range in male and female adults and children.
- 11) The reception and production of prosodic features is poor in deaf. Highest error rates occur for intonation.
- 12) The perception of temporal duration in hearing impaired is different from normals.
- 13) Preceding vowels have an influence on the fundamental frequency of vowels, and voiceless consonants. Final consonants show no regular effect on the fundamental frequency of the preceding vowels.
- 14) The mildly impaired listeners (with flat audiograms) perceive both the mid-frequency patterns and the low frequency patterns equally well.
- 15) The sensorineural listeners have a better perception of low frequency speech patterns, such as voicing, nasal murmurs and the first formants of vowels.

- 16) Low frequency patterns are better perceived in a wide range of degrees and types of sensorineural impairment.
- 17) The fundamental frequency variations are more closely related to the perception of both stress and intonation.
- 18) The higher fundamentals, longer durations, and greater intensity of syllables influence the perception of stress.
- 19) The subjects with serve to profound hearing impairment are found having difficulty in discriminating the second formant region of vowel sounds. The first formant position and duration of vowels are well discriminated by all (except by the more profound cases).
- 20) Auditory perception could be different at different levels of language structure. While independent sound may be more easily perceived, their combinatory operations in the form of phonemes, syllables, words, sentences and discourse could be different.

A survey of studies on perceptual acoustic cues suggests that the residual hearing both in terms of intensity and frequency range influences reception of speech. The studies also indicate that the voicing and nasality features are least affected and the place features are more affected in typical sensorineural listeners. In typical sensorineural impairment, hearing loss increases with increase in frequency. Thus, place features are often not received through audition in the profoundly hearing impaired. One can compensate to same extent by using hearing aids that provide amplification in the high frequency range. But, children may have low levels of tolerance for high frequency place cues audible to the child. Speaking loudly also will not be fruitful. This is because,

when one speaks loudly or quietly, the mid and high frequency place cues are produced at much the same intensity. By taking quietly and also close to the microphone of the hearing aid, one can emphasize place cues (Ling, 1976). Thus, more children with hearing impairment having residual hearing in low frequencies can hear the acoustic cues of vocal duration, vocal intensity, vocal pitch, the F_1 of all vowels, and consonant manner distinctions according to Ling. Therefore, manner cues are more frequently accessible to the hearing impaired than the place cues. Vision is often supplemented to compensate for the missing place cues by these children.

In our present investigation, we found that the difference in quality between a vowel and a consonant is generally always recognized. The vowels are confused only among themselves even as the consonants are confused only among themselves. We also found that the deaf subjects had greater difficulty in identifying consonants. Almost three-fourths of the total number of confusions were found within the group of consonants. The Kannada y , a semi-vowel, is always confused with other consonants, and not with i . All our subjects, irrespective of the degree of severity of hearing loss, showed confusion between a voiced consonant and its unvoiced counterpart. Our subjects did not perceive the aspirated sounds at all. Often our subjects identified individual sounds not directly as the particular sound, but through a combination of several traces which pointed out to a group, rather than a single sound. A significant feature that emerged in our data was that often the deaf subject identified the sounds as forming separate bundles - they tend to put together the sounds which resemble one another in some crucial variable. For example, all the stops were treated more or less as an independent group. Any substitution of a stop consonant was made using another stop consonant, and not by using a fricative, etc. This could not be clearly stated, in our data, for some sounds, namely, the sibilants and glottal fricative h . Sibilants were found to be substituted by stops,

and other fricatives, without reference to both place and manner of articulation. While the bilabial *p* was correctly used, more or less on all occasions, we noticed a confusion between the velar and dental voiceless stop *k* and *t*. There was also confusion noticed between *c*, a palatal affricate, and *t/d* a retroflex stop; presumably, the overall place of articulation was identified, but the manner could not be controlled. Another important feature that we noticed was the lack of a pattern congruity between the voiceless and voiced counterparts of the stop series, a contrast phonemically maintained in the normal hearing population. There were two types of confusions noticed, one in which there is no consistency whatsoever given to the recognition of voiced stop consonants forming part of the phonemes of the speech, and the other in which the voiced stop consonants were used indiscriminately as substitutions of voiceless stops. In other words, the clearly marked distinction between voiced and unvoiced stops in the normal hearing Kannada subjects is not maintained in the speech perception of the hearing impaired.

In the case of the laterals and the nasals, a distinction between the two is maintained, but there are frequent confusions between the two. Also, there was confusion noticed between the sounds of the lateral group. That is, the alveolar versus retroflex distinction is laterals maintained in the normal hearing is not consistently maintained in the speech perception of the hearing impaired. Likewise, the hearing impaired showed some confusion between the five nasals kept apart in the speech perception of the normal hearing populations. However, in most cases, in the initial position, the bilabial nasal was correctly perceived. The alveolar, retroflex and palatal nasals were more frequently confused with the bilabials and less frequently with the velar nasal, which is also correctly perceived in many cases. The trill is often wrongly perceived and is substituted mostly by some voiceless stop consonant, *t* being more frequently used among them.

Among the vowels, **a** is hardly ever perceived wrongly; whereas there is always confusion between the two front vowels **i** and **e**. This consistency cannot be generalized to **u** and **o**, the two rounded back vowels in Kannada. Sometimes **u** is substituted by **a** and some other times by **i**. Similar is the case with **o** which is more frequently substituted by **a**.

One of the problems that we noticed in all our subjects was their inability to maintain normal gaps in the flow of the words between words and between syllables of a single word. While this was the case when they uttered a stretch of utterance, we noticed a wider gap between stretches of utterances than found in between the stretches of utterances of the normal hearing. Thus the temporal progression, or, rather the construction of the temporal progression of the words and utterances clearly marks the deaf speech as deviant.

1.5. Visual Speech Reception

Perception of speech via vision is generally through the process of speech reading. Speech reading is the process by which speech is understood by carefully decoding the shapes and movements generally of lips. It is commonly referred to as lip reading. In academic discussions, the term **speech reading** is preferred because it is not only the lips but also the movements of the tongue, jaw, face and throat, in addition to the communicational context, that play a part in visual reception of speech.

Speech reading in combination with sign or manual language may be the only form available to the profoundly hearing impaired children with no residual hearing. In India, most of the severely and profoundly hearing impaired rely on the visual modality alone for speech reception since speech and hearing training facilities are not readily accessible to them. Moreover cost of the hearing aids is too high for most of the population.

Severe constraints are faced by the hearing impaired, when they resort to speech reading. The speech sounds are distinct when received through the ear. This distinction is to be perceived in the place of articulation when speech reading is adopted. This leads to various problems. Many sounds of a language are produced at the same place of articulation. In Kannada, there are five bilabial phonemes p , p^h , b , b^h and m , there are five velar phonemes k , k^h , g , g^h and $ŋ$; there are five dental phonemes t , d , t^h , d^h , and n ; there are five palatal phonemes c , c^h , j , j^h and $ɲ$; and there are five retroflex phonemes $ʈ$, $ɖ$, $ʈ^h$, $ɖ^h$, and $ɳ$. Therefore, the hearing impaired children face the problem of distinguishing between the phonemes with similar place of articulation; they also face the problem of distinguishing between the phonemes on the basis of manner of articulation. In addition, the visual patterns associated with various consonants range from being clearly visible to ambiguous positions to invisible positions. For instance, while the positions for the bilabial and labiodental sounds are easily visible, the positions for the velar and post-velar sounds are barely visible.

Speech reading is no substitute to real language, nor is it a useful stepping stone for the acquisition of real language. Speech reading does not serve as a speech feedback mechanism. Speech reading raises several questions with regard to interrelationship between modalities. How is the oral language encoded in the form of visual images, articulatory movements or vibratory patterns? How is the message received through lip reading transformed to language and speech? Speech reading also raises language specific questions. Are there culture-bound traits in speech reading? What are the influences of the dialect on speech reading? Are there universal traits in speech reading? What are the specific language constraints faced by the hearing impaired in speech reading in a particular language context? Can there be a hierarchy of elements – from the easily retrievable to the more difficult? How are the combinations of phonemes retrieved?

Do the hearing impaired engaged in speech reading retrieve speech through individual sounds, phonemes, or as combinations of phonemes/combinations of sounds? Or do the hearing impaired perceive speech via speech reading in terms of larger units such as syllables, words or phrases? How are the visible traits of the utterance retrieved through speech reading - such as the initial phoneme/syllable - related to the full form in the normal language?

Following the Bloomfieldian and neo-Bloomfieldian models of linguistics, studies on visual perception of speech have attempted generally to identify the visual reception characteristics for individual segmental sounds in various positions of their occurrence and for supra-segmentals. Attempts have been made to group the phonemes of a language into contrastive units based on visibility. The visibility of consonants and the distinctness of consonants of English and other European languages have been studied extensively. Several studies have identified the visemes (compare this notion with the notion of **phoneme** in normal language description). These include Woodward and Baber (1960).

These studies aimed at ranking various speech sounds in normal language in terms of a hierarchy of visibility - from the highest to the lowest visibility. Note, however, that it was not possible for any of these studies to present an absolute ranking order, sound by sound, for each sound. The maximum that these studies could do is to arrive at a hierarchy for groups of sounds. For example, all labiodental sounds available in the language were found grouped as a single group; likewise all bilabial sounds in the language were also found to fall into another group, and so on. That is, the investigators found that the sounds fall into various groups in terms of their potential for visibility and that all the members within a group had, more or less, the same potential for visibility. In other words, a speech reader is to find means to decide as to which of the bilabial sounds in indeed referred to

by the speaker as failing within the bilabial sounds, at the moment of the speech reader's reading an utterance. Another feature was that while there were some agreements between the investigators cited above as regards the visibility potential of certain groups of sounds and consequent hierarchy, for example, the bilabials were seen by all as having the highest potential for visibility, there were no agreements among the investigators for other groups of 'homophonous' sounds. In essence, there is some disagreement as to the inter se hierarchy of various groups of sounds with regard to their potential for visibility. The hearing impaired persons perceive usually speech by watching the speaker's face. They do it even while they listen through a hearing aid. Normal hearing persons also rely on visual cues, especially when they communicate in noisy or reverberant environments. It should be noted, however, that only a limited amount of information on consonantal identifications is lip-provided.

As already pointed out, most of these studies used normal hearing subjects, and videotapes for the presentation of the test material. They used tests of forced error confusions. The tests aimed at a visibility chart for the phonemes of the language. In some experiments, words of minimal pair types were presented, without any linguistic and meaningful contexts. The results of most of these experiments show that the consonants of a language can be grouped under various categories of contrastive elements. The bilabial category is found in all the experiments as distinct from the non-bilabial. The labiodental category is also seen distinct. In general, the distinction between categories is maintained at the level of point of articulation, rather than at the level of manner of articulation. The broad contrastive categories are of an overlapping nature in the sense that in some of the contrastive categories no clear-cut distinction based on point of articulation is maintained. However, the hypothesis that the correct perception of visemes (phonemes grouped into contrastive units based on visibility) within the same category

is no more than a chance was tested by Lathe (1978) in Indian languages context. Two groups of homophonous categories, bilabials **p, b, m** and the alveodentals **t, d, u**, in monosyllabic structure were presented to 10 normal hearing adults by means of a videotape. The results of the study rejected the hypothesis. It was suggested that some cues not known at present were available to the subjects. Further exploration of the cues such as pressure in lip approximation for the bilabials, tongue contact for alveolars, and the differences in the time of articulation of different sounds, and the cues available from laryngeal region were suggested. Note that elsewhere also similar findings have been reported. The deaf subjects tend to perceive a speaker's laryngeal vibrations and use this information as a supplement to reading. Schienberg (1980) also found that the 'homophemes' can be discriminated at a better than chance level.

The consonant clusters reveal several performance strategies in individual languages. In many languages, clusters get simplified through various processes. Some clusters are more frequent than others. They may become homographically identical or non-identical clusters, heterogeneous or single, tense consonants. There may be double, triple or even quadruple consonant clusters. The clusters in borrowed words may or may not be retained and may have their own behavioural norms. There are certain restrictions imposed on each consonant as to with which other consonants, in what sequences, and in what positions of a word, it can form a cluster. Frequency and variety of clusters which occur in various positions in a word differ from one positions to another. In many languages, the consonant clusters are produced with quick articulatory successions, and, in several others, one could notice a brief hiatus between the elements that form the cluster. Each of these and several others have behavioural consequences in the speech reading of the hearing impaired.

There is a general agreement among the investigators that the consonant clusters are perceived incorrectly most of the time. Very often consonant clusters are perceived as single consonants. It is possible to establish, only to a lesser degree in the case of the clusters than in the case of single consonants, visually contrastive categories based on articulatory positions or movements for each language. The present authors find that, unlike in the visual categorization of single consonants, the visual categorization of consonant clusters exploits also the manner of articulation.

Investigators have found out that vowels tend to be confused more often with other vowels produced in neighbouring articulatory positions. While the back and lip rounding vowels o and u are the most visible, the front and lip unrounded vowels e and i have been identified as the most audible. Ling (1976) has suggested that because the hearing impaired children rely mainly on visual cues, they produce vowels often with appropriate lip shapping but with neutral tongue position.

In many Indian languages, a distinction between short and long vowels is generally maintained at the phonemic level. Some neutralization between long vowel and its corresponding short vowel takes place in the word final position and also at times in the word medial positions. The distinction between short and long vowels is phonemic and as such needs to be acquired by the hearing impaired. Word initial vowels are more prominent than others. In some Indian languages, there are proper vowel clusters in the sense that all the vowels in a cluster maintain their original vowel quality. In several other Indian languages, the combination of one vowel with another vowel may result in diphthongs. A visually contrastive hierarchy for vowels of a particular language is to be worked out taking into consideration the above information. Because length is phonemic, lip shapes well as duration (length of duration in which in which a particular lip shape remains as it is) should be considered as

important visual cues. Including duration as an important visual cue may also help us to relate tones in some of the Indian Languages, like Punjabi. Research in these areas is yet to begin however.

Studies on other languages reveal two conflicting trends: Some investigators, like Ling (1976), have taken the position that since there are no visible articulatory movements corresponding to pitch and intensity, vision does not help the perception of these features. But some other studies, such as that of Berger (1972), have argued that the duration correlate may be contributing to the correct perception of stress in the hearing impaired. The present authors are of the opinion that the investigators have generally tended to seek the determining visual cues for the suprasegmentals. It is through a combination of visual cues that the hearing impaired begins to clearly decode the suprasegmentals and the words and phrases. A dynamic view of the process, with one cue influencing and triggering the other, is called for. In general, the visual perception of prosodic features, in the opinion of the present authors, holds the key for the proper decoding of words and phrases. Instead of working from the consonants and vowels, it may be more appropriate to work out the visual cues for prosodic features first and place, within the patterns of visual cues, the combinatory processes of visual cues for the consonants and vowels. A normal child acquires the prosodies first, before she acquires the lower level units such as words, consonants and vowels. If the acquisition of prosodic features through the auditory modality is denied, in various degrees, in the hearing impaired, it is but natural that the young child resorts to the visual cues to identify the prosodic features.

The modality of vision is already in operation for communication purposes even before language acquisition processes commence. The present authors find that the hearing impaired children assign more functional values to visual cues than normal children do. The prosodic features of the auditory modality also have their closer association with

visual cues in the early stages. With the commencement of oral language acquisition, the prosodic features of the auditory modality take a definite shape and play a crucial role in language acquisition. Since this is denied to the hearing impaired, in various degrees, the prosodic features of the visual mode is to be more elaborated. The literature has not focused upon this elaboration and subsequent embedding of visual cues for words, consonants and vowels into the elaborate mosaic of language communication.

We have already argued that investigations on the inter-relationship between visual cues and individual phonemes and their combinations are not adequate. We have suggested that units larger than the above also should be brought into the scope of investigation. We have further suggested that we start with the investigation of visual cues for the prosodic features and then place within these features the features for other linguistic units. There are several investigations which have focused upon the visual cues for larger units such as words, phrases and sentences. We give below the salient findings and trends in this area of research.

- 1) The lip reading performance is affected by the number of words in a sentence, the number of syllables in a sentence, and the number of vowels and consonants as well as the length of the stimulus words.

- 2) Lip reading is not done one phoneme at a time but by semantic units. The speech reader recognizes the movement seen as something known or unknown (Clouser, 1977)

- 3) Lip reading of sentences is influenced by the familiarity of sentences and by the familiarity of words that constitute the sentence.

- 4) Clouser (1977) reports that the lip reading of sentences is not influenced by vowel consonant ratio in both hearing impaired and normal subjects.

5) Complexity of the sentences is a variable affecting lip reading. The simple kernel sentences may be less difficult than the other transformed sentences.

6) The difficulty in lip reading longer sentences which are of same complexity, as opposed to shorter sentences, has been attributed to shorter visual (iconic) memory than the auditory (echoic) memory.

7) Some authors find that interrogative sentences are more difficult to speech read because they contain an unstressed verb or verb-ancillary in unusual position in English. But it is also found that the attitudinal contents of intonation are easily conveyed by the kinesic signals such as hand or head movement or facial expression. In the case of Kannada, we observed that the interrogative sentences beginning with interrogative morphemes (wh-morphemes) are more difficult to speech read than the interrogative sentences which end with interrogative suffix. The interrogative suffix -a: is added to a declarative sentence to make the latter a sentence conveying interrogation:

avanu ho:gutta:ne	'he goes'
he goes	

avanu ho:gutta:na:	'does he go?'
he goes - does he	

Since an open central vowel is more easily perceived by the hearing impaired, and since there are clearly visual facial movements and expressions, perhaps the hearing impaired is able to perceive the second category of interrogative sentences more frequently.

8) Only a very small percentage (less than 10%) of the discourse material can be speech read by normal

subjects. This shows the difficulty level in speech reading the discourses. Information in, rather, discrete and distinct units, presented in more than one modality and in a more redundant and repetitive manner, will facilitate the progress of discourse communication, with the hearing impaired.

9) Appropriate discrete gestures, and even some appropriate continuous gestures in conversational situations, are factors that enhance speech reading performance. Inappropriate gestures in these contexts decrease the visual speech reception scores. The gestures used in the study of Popelka and Berger (1971), ranged from movements that were close to the speaker's lips to movements that were fairly distant from the lip, and from subtle movement to considerable motion. It was concluded that the peripheral vision of the normally seeing persons allows the simultaneous and accurate perception of both types. Gestures are thought to be operating in two ways: (i) Delimiting the individual word choices within the message and (ii) In an idiomatic manner, whereby the gestures lead to the expectation of a group of words of specific word order.

10) Familiarity of the language is an independent variable that influences the interpretation of visual cues (Albright, et al., 1973). When phonemically similar utterances from two languages are presented to a hearing impaired person, he will tend to show a superior performance with regard to the language known to him. Indian languages offer an excellent ground for research in this area. There are four different language families. Languages within a family are classified under various groups based on similarities and differences in all linguistic structure, and shared innovation. Tamil and Malayalam, Tamil and Kannada, and Kannada and Telugu would be an

excellent target for study in this area. These languages offer phonemic similarity as well as syntactic similarity. They also offer lexical similarity. It will be interesting to see how these similarities are inter-linked in the language of the hearing impaired.

In addition to the linguistic factors discussed so far, a number of other variables interact to affect the speech reading performance. These include the speaker variables, the channel variables, and the speech reader variables. All these interact with one another to influence the speech reading performance. Some of the salient points are as follows:

- 1) Sex of the speaker does not affect the speech reading performance.

- 2) The greater the portion of the face of the speaker exposed to the speech reader the better is the speech reading performance. There is superior performance in lip reading when the whole face is exposed, in comparison to the performance when only the lips are exposed.

- 3) The idiosyncrasies of the mode of speaking of the speaker also act as another set of variables. There is a tendency amongst the normal speakers to exaggerate their speech movements when they converse with the hearing impaired. Stone, et al., have found that the normal mouth movements are preferable to the lips (Stone, et al., 1951).

- 4) Rate of speech of the speaker is another variable. Reducing the rate of speech from the normal rate does not vary the performance of both 'good' and 'poor' deaf lip readers. However, the speed of speech greater than the normal rate of speech may affect the speech reading performance.

- 5) The way the speaker speaks is not the same in all the situations. The rate of speech may change

when the speaker is emotional; it may increase under certain emotional conditions and it may decrease and be of a faltering type under several other conditions. Chewing and eating situations, wherein the mouth is full, may also influence the speed of delivery. Certain contents require slower/speedier delivery. Some may cover their mouths in many ways and speak. Still others may speak with their hands or fingers placed beneath their chin. The lip reading performance is superior when the speaker's face is clearly seen without any obstacles.

6) Speech reading of familiar and unfamiliar speakers must be distinguished. Speech reading a familiar speaker is like the deciphering of children's speech in early stages of acquisition by the members of the children's family. All constructions are interpreted within a communication context, shared by the child and the members of the family. Speech reading a familiar speaker is based on accumulated visual cues already in the store of the hearing impaired. There is already a sharing of the communicative context between the speaker and the hearing impaired, whereas for the interpretation of the unfamiliar speaker, new bridges of communication are to be built.

7) In the normal hearing population, visual cues play an important role in face to face communication. We have observed in our study that when a subject is seated with body, head, and eyes oriented in the same direction, speech coming from the front is better perceived than speech coming from other directions. This is not based purely on the likelihood of directly receiving and perceiving the acoustic energy emitted, but more on the possibility of contributions by the visual cues to the linguistic communication. In the case of the hearing impaired, frontal position enhances the reception potential for acoustic energy even as it

enables the hearing impaired to make approximations towards speech uttered via the visual cues. It may be pointed out that, even in the normal hearing also, recognition of speech sounds in word contexts is better when presented in the combination of auditory-visual modes than only through the auditory mode.

1.6. Tactual Speech Reception

The tactual modality helps the profoundly hearing impaired and the blind child in their speech reception. Taction also supplements visual speech reception in the profoundly hearing impaired children. The presence or absence of voice, its relative duration and intensity, the pitch of the speaker's voice are the identifiable by touching the speaker's chest and/or face properly. The vibration on the bridge of the nose gives information about the nasals; information on plosives is seen in the sudden release of air; the voiceless and aspirated stops are identified with relatively greater airflow than the voiced stops. The table below gives the details.

With fingers, finger-tips and/or palm, taction at	Category of speech perceived
1. Speaker's chest or face	The presence or absence of voice, its relative duration, its intensity and pitch (Ling, 1976).
2. Vibration at the side of Throat	Presence of vowels, diphthongs, and voiced consonants.
3. Hyoid depressed	Production of velar consonants k and g.
4. Hyoid bulging	Production of vowels i and u.

With fingers, finger-tips and/or palm, taction at	Category of speech perceived
5. Emission of pulse of air from the oral cavity	Plosives, stops, and affricates.
6. Emission of sharp or diffuse flow of air from the oral cavity	Fricatives sharp s, diffuse š, ʃ.
7. Jaw and lip movement	Cues for position of mandible and lip for various vowels, diphthongs and consonants.
8. Vibration at the side of the nose	Nasalized vowels and nasals consonants.
9. Emission of air from the nasal cavity	Nasal consonants and nasalized vowels.

Theoretically speaking, it is possible to identify the likely tactile cues for the speech sounds of a language based on the articulatory description of speech sounds of the normal hearing. This is what we present in the following table. However, it should be borne in mind that these are only likely tactile cues and that, in reality, it is open to every hearing impaired child to devise his own tactile cues for the speech sounds, which need not be based only on the articulatory characteristics of the speech sounds. Moreover, a hearing impaired child will not develop tactile cues for all the speech sounds, only some are chosen and tactile cues developed. Our subjects further showed that, even when some tactile cues are prominent, such as the heavy puff of release marking the production of aspirated stops in Kannada, they may either ignore using these cues or associate the same with some other closely resembling sounds such as unvoiced stop consonants

in Kannada, if aspiration does not play a crucial role in the language. It is not clear, however, how the hearing impaired arrive at this rather correct but surprising conclusion. Perhaps the residual hearing helps them in some manner in this case.

Tactile Cues for Kannada Speech Sounds

- P** : Emission of explosive pulse of air from the oral cavity.
- b** : Emission of explosive pulse of air from the oral cavity.
Vibration at the side of the throat. Mandible from high position depending on the following vowel.
- t** : Emission of explosive pulse of air from the oral cavity.
- d** : Emission of explosive pulse of air from the oral cavity.
Vibration at the side of the throat. Mandible from high to low position depending on the following vowel.
- ʈ** : Emission of explosive pulse of air from the oral cavity.
- ɖ** : Emission of explosive pulse of air from the oral cavity.
Vibration at the side of the throat. Mandible from high to low position depending on the following vowel.
- ɕ** : Emission of diffuse pulse of air from the oral cavity.
- ʃ** : Emission of diffuse pulse of the air from the oral cavity.
Vibration at the side of the throat. Vibration of front of tongue.
- k** : Emission of pulse of air from the oral cavity. Mandible depressed. Rear position of the chin/floor of the oral cavity raised and lowered.
- g** : Emission of pulse of air from the oral cavity. Mandible depressed. Vibration at the side of the throat. Rear portion of the chin raised and lowered.
- p^h** : Same as for **p**. Pulse of air is of greater intensity.

- b^h** : Same as for **b**. Pulse of air is of greater intensity.
- t^h** : Same as for **t**. Pulse of air is of greater intensity.
- d^h** : Same as for **d**. Pulse of air is of greater intensity.
- ʈ^h** : Same as for **ʈ**. Pulse of air is of greater intensity.
- ɖ^h** : Same as for **ɖ**. Pulse of air is of greater intensity.
- k^h** : Same as for **k**. Pulse of air is of greater intensity.
- g^h** : Same as for **g**. Pulse of air is of greater intensity.
- m** : Vibration felt at the nasal bridge. Emission of breath
from the nasal cavity.
Vibration at the side of the throat. Mandible from high
position to low position depending on the following
vowel.
- n** : Same as above.
- n** : Same as above.
- ɳ** : Same as above.
- ṇ** : Same as above.
- ṅ** : Same as above. Mandible depressed. Rear portion of
the chin raised and lowered.
- f** : Emission of air between the upper teeth and the lower lip
- s** : Emission of sharp flow of air centrally between the teeth.
- ʃ** : Emission of diffuse flow of air between the teeth.
- ʂ** : Same as above.
- h** : Emission of air from the oral cavity.
- l** : Vibration of the side of the throat; mandible from high
position to low position depending on the following
vowel.
- ɭ** : Same as above.
- r** : Same as above.

- v : Vibration at the side of the throat. Mandible depressed.
- y : Vibration at the side of the throat. Mandible raised or lowered depending on the following vowel.
- i : Vibration at the side of the throat. Mandible depressed. Hyoid bulging.
- i: : Same as above; but, for longer duration.
- e : Vibration at the side of the throat. Mandible depressed. Hyoid bulging.
- e: : Same as above; but, for longer duration.
- æ : Vibration at the side of the throat. Mandible depressed. Hyoid is not bulging.
- u : Same as above, but, hyoid is bulging.
- u: : Same as above; but, for longer duration.
- o : Same as for u.
- o: : Same as above; but, for longer duration.
- a : Vibration at the side of the throat. Mandible depressed.
- a: : Same as above; but, for longer duration.

The table above presents tactile cues for the phonemes of an Indian language (Kannada); the cues are based on a blend of empirical observations and our own intuitive analysis of the situations encountered. It may be noted, however, that there are severe constraints in the identification and use of tactile cues, from the investigators' point of view, and from the point of view of the hearing impaired. First of all, tactual perception of speech is more effective if multiple sites are exploited. Secondly, such cues need to be very intelligently linked with some mental token (concept). While the cues are invariably syncretic, there is a need to identify distinguishing features even among the syncretic cues. Moreover, the sequential organization of these cues for a progression and expression of the communicative intent is also necessary.

Studies have demonstrated that taction is a viable modality to supplement a deficient auditory mode; but the usefulness of taction for speech reception in the hearing impaired in a communicative context is rather limited. We should also emphasize that all the hearing impaired individuals do not uniformly follow the same methods of using tactile cues; nor do they uniformly choose some particular sites for taction. There is a great variety. There are several success stories in which the hearing impaired have been reported to have used tactile cues as the only means of perception. But, more often than not, taction is seen to improve the quality of speech perception through other modes such as speech reading. Plant and Spens (1986) reported a case history of a 48 years old Swedish male developed a method to perceive a speaker's laryngeal vibrations by placing his hand on the speaker's shoulder with his thumb pressed lightly against the side of the neck. This method improved his speech reading ability of sounds, syllables, words, sentences and discourse. Used alone, the method helped the subject to perceive consonant voicing surprisingly to an extent of 99.3%. Likewise, the subject could identify the manner of articulation of consonants also to a very high degree. Perception of syllables in words and sentences, and emphatic stress in sentences were also high. Such stories of success, while emphasizing the difference in modality preference in the hearing impaired, also point out to the quality of cognition retained in spite of the deficient hearing potential.

1.7. Speech Reception Through Audition and Vision

Vision constitutes an important factor in speech reception, just as audition. Indeed, a well coordinated effort between vision and audition is necessary for speech reception. In normals, when audition is hampered by high background noise conditions, vision helps restore speech reception. Vision supplements the speech reception by the hearing impaired children. For the analysis of the inter-relationship between the two and the effect of these two on the hearing impaired, two

types of studies have been carried out. In one type of studies, scholars have examined the performance of the hearing impaired under auditory, visual, auditory-visual presentations of the test materials for speech reception. In the second type of studies, investigators have tried to simulate the hearing loss by presenting background noise in the test situations to the normals. The general consensus is that the audio-visual speech reception is superior to the audition-alone condition. Features of voicing and nasality are recognized under noise conditions, whereas place of articulation is difficult to perceive. Under audio-visual conditions, the place of articulation shows substantial increase in intelligibility. Walden, Prosek and Worthington (1974) showed that auditory-visual perception of speech is superior to auditory perception alone. They classified the consonants on a six feature system: voicing, nasality, liquid glide, frication, duration and place of articulation. In the auditory reception-alone condition, the transmission of place of articulation feature is substantially less than that of other features. In the liquid glide feature that is best transmitted, voicing and nasality are perceived slightly better than that of duration and frication. Perception of duration, place of articulation, fricative and nasality features show an increase with the aid of visual component. The reception of the liquid glide shows less improvement than the above four features. Moreover the effect of visual cues on the reception of voicing information is minimal. Other studies indicate that vision has a greater effect on the reception of consonants than on the reception of vowels, words, and phrases, and that younger people with congenital disorders benefit by vision more than the older people who become hard of hearing through aging.

Most of the laboratory studies are of the opinion that auditory-visual speech perception is superior to visual or auditory perception alone. But the maximum audio-visual scores obtained are dependent on the severity of the hearing loss of the subject, room acoustics, the linguistic unit to be

perceived, and age of the patient. Most studies have emphasized recognition of single and initial sounds only. Studies have generally ignored the contribution of the communication context, the context of situation. Byman (1974) emphasizes that speech perception in every day communication should be subject of investigation. The restricted laboratory environment is not the right backdrop for a generalization. Byman suggests that at the very beginning of an interaction each of the participants attempts to categorize the communication situation. This categorization, if confirmed, will activate a certain set of expectations. The participant's knowledge of what is relevant to the topic of conversation also influences his expectations and anticipations of what the speaker is going to say next. Thus, a comprehension of the communication situation is a prerequisite for the comprehension of speech.

1.8. Speech Reception Through Vision and Tactual Modalities

Studies on speech reception through a combination of vision and tactual modalities indicate that high frequency consonant sounds such as s and t can be differentiated when speech reading is supplemented by touch. In tests with combined lip reading and tactual reception, the tactual information on consonant and the number of syllables was found to improve transmission without detracting from lip reading the visible features of other sounds (Pickett, 1963). Since place of speech production features are speech read better than the manner of articulation features, tactile aids to supplement the latter may enhance speech reception (Ling, 1976).

Miller (1974) examined the relative effectiveness of the visual, and the combined tactile and visual modality on speech reception. The vibrotactile speech reception aid transmitted the cues from the nasal vibrations, equalized speech sounds that throat vibrations. The subject placed his 5th, 3rd, and 2nd

fingers on the nose, microphone and throat vibrators. The results indicated superiority of the combined conditions. Phonetic features of voiced/voiceless, continuant/interrupted, and nasal and oral were discriminated well. Changes in vowel duration with changes in final consonants were clearly felt, while the tense/lax distinction of vowels was not clear. The listed cues together with those available by lip-reading are said to provide complete information of the segmental features of English.

In conditions of simulated profound deafness in normals, subjects have reported that a few words and phrases do not match the received patterns through lip-reading. Ambient noise conditions tend to distort the reception of the temporal patterns of speech. But, tactual vibration is found to improve the rhythm of the speech of the hearing impaired.

1.9. Speech Reception Through Auditory and Tactual Modalities

Though the preference is to provide the child with both tactual and auditory modalities by most researchers, research in this area is scanty. Boothroyd, et al., have devised a hearing aid with tactile output. Providing the child with tactile display in addition to amplification were said to bring about improvement in voice control, and syllable discriminations.

1.10. Multisensory Speech Reception

Even in normal population, communication is carried on through multisensory organs. In the speech of the normals, there is an interplay of oral speech with vision and taction. The normal multisensory speech reception includes speech reception through hearing, vision and touch. in the hearing impaired, there is a greater reliance on the multisensory speech reception. However, in order to identify the relevance and wieghtage of each of these modalities vis-a-vis one another and for the total communication process, it is necessary to undertake suitable experiments. It is also necessary to investigate as to whether the simultaneous use of all the three

modalities inhabits or facilitates communication in the hearing impaired. The efficiency of the combination in all situations, while conversing at different distances and speeds, reading and writing, playing, etc., needs to be examined. A fruitful approach would be to investigate the variables of interplay of multisensory communication. In normals, the non-oral communication supplements the oral communication and, in certain specified conditions, precede/follow/accompany oral communication. The non-oral communication is seen superior to oral communication in certain contexts in all cultures. For the hearing impaired, the non-oral communication is almost as important as the oral communication. The non-oral modes not only supplements the oral mode in the hearing impaired but also acts as a means to interpret the oral mode; the non-oral mode has a greater independence, acts as a greater independent means of communication in the hearing impaired (Thirumalai, 1987).

Current research has attempted to allocate areas of operation for each of the modalities (vision, speech and taction) in the speech reception of the hearing impaired. The research has attempted to show how certain particular cues of vision and taction are exploited to identify certain cues of speech or rather certain variables of speech such as sounds. For instance, Ling (1976) may be cited as an excellent example of this orientation. Ling (1976) suggests that the child's attention is directed towards vision, if place of articulation is to be received, and towards audition and touch, if supra-segmental feature is to be perceived. Ling as also identified the types of speech features available, partly available, or unavailable in speech reception through each sense modality. This orientation is certainly valuable and has immense practical applications. However, the present investigators are of the opinion that an integrated orientation is not only possible but could act as a better alternative. By the integrated orientation, we mean that we could identify units of communication in the hearing impaired. These units of

communication are not to be found focused only on speech. The unit is a blend on speech for its building blocks. The unit of communication in the hearing impaired is an integrated whole of speech, vision and tacton. Only by taking this view will we be able to explain the communication abilities of the hearing impaired and describe the communication process itself, a process that is carried on even with deficient speech and hearing.

CHAPTER – II

EARLY LINGUISTIC BEHAVIOUR IN THE HEARING IMPAIRED

2.1. Introduction

The normal child begins to use meaningful utterances right from her birth, even though the discrete linguistic units may appear only later on. The same thing must be expected also of the hearing impaired child; in this case, the emergence of the discrete linguistic units may be delayed and their functions may not be clear, or, may not be that weighty as found in the normal child's speech. In any case, before, during and after the emergence of discrete linguistic units, the normal child goes through a simultaneous development on the receptive side. While the ontogeny of speech production in the normal has received tremendous attention from the investigators, the ontogeny of reception in the normal has not received equal attention. In the case of the hearing impaired, both speech production and speech reception have received only very little attention. The ontogenetic stages of speech production and speech reception are not discrete and the segmental and supra-segmental aspects of one stage may overlap with the next. Note also that each of these stages is characterized by previously unobserved linguistic units of various linguistic levels. Perhaps this is the only justification that one could find for establishing "stages". This defining characteristic, however, is not tied down to any one particular item in the stage across children.

Investigators have identified several stages in the production of oral sounds. In recent publications, Cruttenden (1979) identified two stages: neonatal period characterized by development and distinction of cries, and segmentals and the babbling period (approximately 0 : 9 to 0 : 10). According to Stark (1979), the five early stages in sequence include reflexive crying and vegetative sounds (0 to 8th week), cooing and laughter (8 to 20th week), reduplicated babbling (25th to 50th week), non-reduplicated bubbling and expressive jargon (9th to 18th month). Van Riper (1978) distinguished the following stages: crying v. comfort sounds (upto 2 months), private babbling (8 weeks), vocal play (5th or 6th month) and inflected vocal play (8th month). Reflexive vocalization, babbling (6th month), lalling (around 2nd to 6th month) and echolalia (9th to 10th month) precede true speech, according to Berry and Eisenson (1956). Blache (1978) recognized the following stages: reflex vocalization, babbling (between 2nd and 6th month) followed by stage 3 characterized by lalling, inflected vocal play, and echolalia (between 6th to 12th month). The child begins to use conventional speech patterns between 10 and 19 months (Van Riper, 1971; Berry and Eisenson, 1956), 12 to 16 months (Blache, 1978), and by the end of the first year (Cruttenden, 1979).

For some years, researchers have concentrated their observation upon the prelinguistic tendency to produce stably significant but idiosyncratic sounds (as an example, Dore, Franklin, Miller and Ramer, 1976). Werner and Kaplan (1952), for example, have used the term **vocable** as a general purpose indicator of the significant pre-linguistic vocalization, and **sensory-motor morpheme**, when gestural context, gestural significance, or, in general, non-semantic significance, is involved as well. Still others have concentrated their attention on nonverbal language development in the early stages. Gray (1977) has studied how a child learns to take an object from the mother; Clark

(1978) has studied the transitions from action to gesture. A linguistic study by Oller, Wieman, Doyle and Ross (1976) on normal children tends to support the notion that there is much similarity and progressive development between the early stages of vocalization and the later symbolic period.

While much work has been done in normal children on verbal linguistic aspects, longitudinal studies in the hearing impaired during the early linguistic periods are not found much. There is a need for the detailed analysis of segmental and supra-segmental aspects of the vocalizations in the hearing impaired. These results may be compared with those of normal children to facilitate the quantitative and qualitative deviancies in the hearing impaired's oral production. The reason for the lack of such studies could have been due mainly to the difficulties faced as regards early identification of the hearing impaired children. The disorder of hearing impairment is invisible directly to the eyes. So, it is identified by many parents at a later age only. The hearing impaired babies typically stop to babble or tend to remain silent from around six months. This may be the first or the only symptom identified by the parents. This may be true especially in India, wherein there are hardly any programmes in the hospitals to identify the high-risk babies. An initial attempt to detect high-risk babies and develop a high-risk register for Indian population has been made by Ashok Kumar (1981). Unfortunately, this work remains unpublished.

The importance of linguistic analysis of the hearing impaired children's oral productions will be recognized with greater strength, if their relationship to later linguistic development is identified. The debate amongst the researchers along these lines is discussed later in this chapter.

2.2. Vocalization Studies

Several questions may be raised when one studies the vocalizations of young children. The first question is

what vocalization is and what items can be constructed as vocalizations. The other relevant points to be considered are the classification of vocalizations, identification of units of vocalizations in relation to adult linguistic vocalization units, comparison of the stages of the emergence of vocalization units in the hearing impaired with those of the normal children, and the specific relations between the units of vocalizations and the beginning of the language.

Cries and noises made through oral and nasal cavities are termed vocalizations. Though all the cries and noises made by the baby are all pregnant with communicative potential, one may posit two broad stages in the ontogeny of cries and noises. The first one is, indeed, very brief, during which the baby cries and makes noises as a self-expressive mode. In the later stage, the baby cries with a deliberate communicative intent, or at least the baby recognizes/seeks the presence of 'the other' for some purpose. The former may be compared to the egocentric speech of children. These early self-expressive vocalizations have an activating function - these activate the process of communication, and slowly tunes the organs of speech communication. From the self-expressive role, the later vocalizations take the child to the communicative context wherein the child and some other persons/objects are involved. At this later stage there is a possibility of recognizing certain recurring patterns and identifying certain categories or manifestations of vocalizations. We already said that the cries and other types of noises form part of vocalizations. Under the other types of noises we include babbling and lalling also. Attempts have been made to analyze babbling into various sounds and link these sounds with the emergence of certain speech sounds. Attempts have also been made to categorize cries into various types. The problem faced by the investigators is to link the classification of cries with the classification and categories of babbling and lalling, and to identify the

processes by which the units of one type (for instance, the cries) change into the units of another type, assuming that there is a progression is assumed, the investigator faces the problem of allocating functions to the concurrently occurring types and the units underlying them. For example, Menyuk (1972) classifies the cries of an infant into linguistic units - single cries are comparable to phonemes. They are also comparable to morphemes in adult language. The cry cycles are analogous to morpheme combinations, sentence-like semantic units. The cry sequences may be compared to a paragraph of speech. Menyuk's attempt is rather ambitious; what we should seek are the recurring formal patterns, to begin with. The duration and intensity and, in general, the acoustical quality of the cries must be considered, instead of looking for units comparable to those of adult speech. Indeed, it is too early in the ontogenesis of speech to expect phoneme-like or even morpheme-like units in vocalizations. The analysis of vocalization is more insightful and faithful to real conditions, only when conducted on the model and basis of the emergence and analysis of thoughts in children. Children exhibit amorphous and syncretic thoughts. The amorphous thoughts are sculpted into individual thought units which are later combined to form sequential structures; the post-babbling speech is also amorphous in the sense that the form of this speech is quite different from that of later day child's speech and the speech of the adults. The amorphous speech is slowly sculpted into units of phonology and other levels through a process of approximations to the adult language. We argue, then, that a study of cries should not look for phoneme-like and even morpheme-like units, but only for several amorphous units of cries based on duration, intensity and other acoustical qualities. These amorphous units should be seen as transforming into linguistically oriented amorphous units.

Options differ on the relevance of the studies of vocalizations, including the studies of cries, for the early detection of hearing impairment in babies. Some investigators report that the characteristics of cries of the hearing impaired children do not differ from those of normal children upto the age of four years (Sedlačková, 1973). Some other investigators have suggested that both crying and laughter in deaf children are atypical in inflection, pitch range, and acoustic quality. It is claimed that the cries are flat in intonational patterns and that the intensity variations may be unusually great. There are two methodological issues involved here. Firstly, there is great difficulty in establishing through a single means that the subjects (young babies) under investigation are hearing impaired. Any decision about their hearing impairment status has to wait until the subjects could be put through audiological and other tests later on. The very young babies are difficult to be subjected to these tests. This situation is in itself not unscientific, although it has all the elements of the fallacy of circumlocution. Secondly, the two views listed above are based on their underlying assumption as to where there is any link between the vocalizations and later day speech. The first view is based on the assumption that there is no link between vocalizations and later day speech and the second view is based on the assumption that there is a link between vocalizations and later day speech. The present investigators argue that vocalizations may be seen linked not only to later day speech but also to the thought process. The subjects with profound hearing impairment are also seen to exhibit some sort of vocalizations in their efforts to communicate. Vocalization must, indeed, be seen as a launching pad for both speech and thought processes, a mode basic to both. Vocalization, in our view, then, is a point from which the unity of thought and speech begins to proceed on separate (perhaps parallel) lines (to meet again in language use). We view, then, vocalization as neutral to both speech development

and hearing impairment. The effects of the hearing impairment must be sought, not in the basic vocalization, but in the post-vocalization wherein a transfer from vocalizations including babbling is being made to linguistic speech. Our conclusion regarding the neutrality of vocalizations in relation to hearing impairment is strengthened also by Lenneberg (1965) who made recordings to spontaneous vocalizations to deaf babies from the first month. He found that the voices of the deaf babies were similar to those of hearing children and that the cooing sounds, laughter and sounds of discomfort were not different from those of normal subjects.

2.3. Studies on Babbling

During babbling, control of the articulatory apparatus is achieved. This control is exhibited through the child's ability to produce a few sounds that are linguistically relatable to later speech. These sounds are generally stops and nasals. The child also comes to realize that she can play with these sounds. The tuning of the organs for speech is the major function of the babbling stage. Is this tuning dependent on any building up of a communicative context or is it mainly a self-expressive mode? Is hearing in any way connected with the quality of babbling?

Lenneberg (1965) found that the hearing children were much more vocal in the presence of others than the deaf. While the deaf had a tendency to engage in certain types of noise more frequently, the hearing produced a wide range of speech sounds in the babbling period. Mavilya (1972) found that babbling was present in the 16 week old hearing impaired infants. Babbling was at its peak by 23 weeks, 17 weeks and 25 weeks in three subjects but an abrupt decline was noticed in 24 weeks, 19 weeks and 26 weeks respectively. With the decrease in babbling, there was an increase in silence, confirming what Eisenson

(1958) concluded earlier that the speech development of the congenital deaf ends with the babbling stage. There are many studies which take the same position.

Some scholars (for example, Mowrer, 1960) have argued that the deaf infants do not babble or babble only very little, because there is no secondary reinforcement to generalize their own vocalizations. This view relates the development of babbling to the development of auditory feedback loop. Fry (1966, 1973) finds a strong link between the tactual and kinesthetic impressions and the auditory sensations that the child receives from his own utterances. The present investigators do not find it necessary to ascribe all such functions to the babbling stage. It has the function of tuning the speech organs and the resultant babbling stream is more basic. It is seen in all disordered children, and in some it may be the only form of 'vocalization' in later day 'speech'. Accordingly, our argument is that the link between the tactual and kinesthetic impressions and the auditory sensations are built slowly with the explicit emergence of linguistic sounds in children and not connected with babbling. This is a very complicated process closely linked with the development of processes of speech perception.

The effect of hearing impairment is felt when speech communication is to begin at the fading of babbling. In other words, the question is about the role of babbling in the development of language acquisition. The essentiality of babbling for normal language development is to be demonstrated through its relation to the emergence of speech sounds of the language in question. So long, babbling is considered a universal feature, not related in any specific manner to the sounds of the language to which the baby is exposed. Secondly, if babbling is essential, the essentiality should be demonstrated in terms of its role in the child's discovery of language rules. The second

demand is rather very stringent and yet it is a reasonable one.

With regard to the relationship of babbling to later phonological development, there have been two sets of theories. We have also earlier referred to such a distinction. The two sets are: (i) the discontinuity theory and (ii) the continuity theory.

The former theorists hold the position that there is no relationship between the early vocalizations or babbling for later phonological development. Jakobson (1968) and Lenneberg (1967) are the major proponents of the discontinuity theory. In passing from pre-language stage to the first acquisition of words, the child nearly loses all of his ability to produce sounds (Jakobson, 1968).

Lenneberg (1965, 1967 and 1973) regarded babbling to be a period of biological maturation. Cooing and babbling stages are not a sort of practice for future verbal behaviour. An example of a 14 month tracheotomized child for a period of six months was presented. A day after the tube was removed, and the opening was closed, the child produced babbling sounds typical of that age. No practice or response with hearing his own vocalizations was required. Comparable observations were noted in other hospitalized children. Some of the other studies that conform to this view are those of Irwin (1947a,b, 1948), Irwin and chen (1946), and Carroll (1961). Note, however, that Gilbert (1982) presents a severe criticism of Lenneberg's position. He says that it is, indeed, a myth to assume that deaf infants babble until the age of six months and then stop. He finds that the data provided by Lenneberg is inadequate. Gilbert's data does not show any significant difference in cooing, crying, and fussing in children of deaf and hearing parents. Since there is no large scale study of babbling in deaf children has been conducted, the conclusions on the subjects must be treated as unfounded, according to Gilbert.

In contrast, the continuity theorists state that there is a continuity in the development of oral speech production from one stage to another. There fore, babbling is gradually shaped to meaningful words. Some of the studies that conform to this theory are those of Moskowitz (1970) and Stark, Rose McLagen (1975), Stark (1979), Stern, Jaffa et al. (1975), Bates (1973), Elliot (1982), Nakazima (1978), Maccoby (1966), Blount (1970), Cruttenden (1970), Oller, Wieman, Doyle, and Ross (1976), and De Villiers (1978). In addition to the above two theories, there are at least four more positions which also require our attention. These are: Babbling as a reinforcement (Mowrer, 1950; Winitz, 1969), Babbling as an imitation (Van Riper, 1971), Babbling as a neurological process (Salus and Salus, 1973) and Babbling as a pre-paratory process for later speech (Berry and Eisenson, 1956; Eisenson, Aller and Irwin, 1963; Berry, 1969; Hurlock, 1956).

Most of the studies reviewed above suggests that continuity exists from one stage to next stage in the first year of language acquisition. However, in our largely impressionistic survey of the hearing impaired children, we find that there is stoppage of linguistic behaviour after babbling. The hearing impaired children do not pass through the lalling stage (as defined in Berry, 1969). This is the stage in which hearing and sound production become associated. The hearing impaired do not also pass through the echolalic stage. This has been noticed by several investigators. The stoppage of linguistic behaviour in hearing impaired after babbling has instigated researchers to seek qualitative deviances at the babbling stage in the hearing impaired. Of the theories discussed earlier, the theories of reinforcement, and imitation give primary importance to auditory sense in babbling and this auditory sense is deficient in the hearing impaired, which hinders further speech development. Thus, one is tempted to conclude that within the framework of the above theories,

the hearing impairment is an independent factor the influence of which becomes more apparent and drastic during (?)/ after babbling. This has led to suggestions that, if external sounds are made audible to the child, then, the breakdown in the process of speech development may be prevented. Whetnall and Fry (1964) suggest that if suitable auditory prostheses are provided, the child will, then, pass through the various stages of normal development. If is also necessary that suitable reinforcements do not increase the vocalizations in infants (Weisberg, 1963). Social reinforcements such as a smile, a word, tackling the subject's chin, etc., increase vocalizations. The studies suggest that the vocalization rates and the length of vocalizations can be altered with reinforcing stimulus. While some studies suggest that socialized reinforcements are important, others have reported that the auditory alone, visual alone, and tactile alone, may result in the change in the rate of vocalization in normal infants.

The present investigators are of the opinion that there is no guarantee that adequate reinforcements would lead to better vocalizations in the hearing impaired. Secondly, there is no guarantee that better vocalizations in the hearing impaired would automatically lead to acquisition of speech. Thirdly, the result that may be obtained through reinforcement is of a limited nature. Stability and continued use of items learnt through reinforcement is possible only for a few items. The manipulation of the items learnt to meet newer situations is not generated by reinforcement. It appears to us that hearing must be considered independent of production - both act as parallel lines until soon after babbling, when linguistic sounds and linguistic structures begin to emerge; the emergence of these is, indeed, the combination of, or the beginning of the combination of speech production and hearing. Relationship between language and thought is an excellent model to explore the relationship/ontogenesis of speech and hearing.

2.4. Prelingual Deafness

In addition to attempts to relate certain characteristics and stoppage of babbling to prelingual deafness, researchers have tried to convert the prelingual deafness to the characteristics of rate of heart beat, state of alertness and orientation to sounds by new-born infants (Muir and Field, 1979; Eisenberg, 1976; Suzuki, 1978), and spectrographic analysis of the newborn infant cry (SirviÖ and Michelsson, 1976). Research findings of these attempts are not conclusive. Evidence, however, is mounting in support of 'incipient affective system as well as a linguistic processing system' (Eisenberg, 1976). And yet at the moment the best we could say about these attempts is that these findings are likely to be useful as a supplementary tool for evaluating hearing in infants.

Another important dimension of research as regards prelingual deafness is the role of cognition vis-a-vis prelingual deafness. We have referred to the possible debilitating influences the early deafness has for both normal behaviour and language acquisition, in the first chapter. The study of auditory deprivation from birth indicates possible permanent deficiency at a cortical level in the hearing of complex sounds, for example, speech (Kyle, 1978). We noticed in our impressionistic survey of young deaf children that in most of them there is a resistance to use language. They start crying, they use jargon, tantrums, reduplication and onomatopoeia in place of actual language sounds/syllables/utterances, etc. In some we found willingness to produce speech if only they have been exposed to language continuously and if they have, thus, internalized some language structure before actual production of speech. When cognition and language are viewed as separate and independent entities, cognition alone does not become a sufficient reason for language acquisition, since language exhibits utterances not connected with thought processes. That is, even as there is

prelinguistic thought, there is also language without thought. However, in normal language acquisition and normal cognitive development, one easily attests the beneficial mutual influences of the two. This beneficial mutual influence is conspicuous by its absence in the early deaf. There are some problems of ideation as evidenced in our subject's inability to use and comprehend simple abstract relations through linguistic terms and simple abstract items such as colour and possession. But this comes to be proved only at a later stage, say, around 3 years in our subjects. We were not able to identify the problems of ideation explicitly in ages prior to this age group, perhaps because deficiency at this stage is easily comparable between the normal hearing and hearing impaired children through language use. And yet we should identify if and when differences emerge in the cognitive development of deaf children as compared to hearing children and the nature of the differences.

There is some relationship between middle ear pathology early in a child's life and subsequent auditory processing deficits (Zinkus and Gottbeg, 1978). Chronic otitis media may affect early language development, in particular perception difficulties are noticed with regard to sounds (Dobie and Berlin, 1979 and Menyuk, 1979). Shah, et al. (1978) find that mean age for suspicion of congenital hearing impairment is 16 months.

In the study of language acquisition by normal hearing children, there has been a lot of interest with regard to rate and quality of language acquisition in relation to mother's speech uttered to children. While there are not many studies on the language used by mothers to speech to/interact with their deaf children, the available studies have brought out some significant findings. The mother of the hearing-impaired child is seen to spend more time monitoring the child and less time playing than the mother of the normally hearing child (Neinhuys and Tikotin, 1983).

There are conflicting reports of the role of mother's utterances in the early language development of deaf children. While Kenworthy (1986) reports that caregiver language input may be significantly affected by the presence of a hearing impairment in the child, Cheskin (1981) found that all mothers used most of their language to describe or control behaviour. she also found that the maternal utterances had five functions: (i) controlling child's behaviour, (ii) prodding, (iii) eliciting, (iv) describing objects and events in the environment, and (v) engaging in incidental conversation. Cheskin (1981) reported that each mother spoke in short sentences that were usually grammatically complete, used a repetitious and restrictive vocabulary, and repeated her own utterances far more frequently than do mothers of hearing children. The mothers of deaf children miss opportunities for involving their children in verbal interactions. It is also reported by scholars (for example, Champie, 1981) that the households of deaf children do not engage the deaf children much in true symbolic communication process. Signing to children is found to improve early language skills in some studies. Lyon (1985) finds the features associated with increased child initiative and relatively less maternal control would help increase language development in the early deaf children. As regards specific language units, Shafer and Lynch (1981) report that the prelingual deaf children used single word utterances for an extended length of time. They also find that the prelingual deaf children use more semantic functions to the oral items they utter than the normal children, showing an inability to acquire necessary forms. Some linkage in the form of chaining of words is sought to be established by the prelingually deaf children in their language acquisition process. Mogford, Gregory and Keay (1979) found that while there were no differences between the pairs of hearing children and mothers on the one hand, and the pairs of hearing impaired children and mothers on the other around the age of 18

months as regards the time spent in joint attention to picture books, length of dialogue, turns per dialogue and proportion of dialogue initiated by mother and child, there began at the age of two, just within a gap of six months, an increase of quality in all items for the pair of hearing child and mother, whereas the deaf children did not show any significant increase in quality. That is, by the age of two years, there was qualitative divergence between the normal hearing and deaf children in matters such as attention to communication, length of dialogue, turns per dialogue, etc., the features that govern normal communication via language. The deaf child began to show the disruption of basic requirements for conversation. Lederberg (1984) reports that the hearing subjects and deaf children and considerable trouble maintaining their interactions. The hearing subjects tended to spend half as much time interacting with deaf children as with hearing children, although the hearing subjects did adapt their communication to the needs of the deaf children in several ways - use of more visual communicative devices, touches and simpler diction and syntax. The deaf children were noticed to be more passive and less actively involved in the interactions than the normally hearing children. Also it was noticed that the mothers of deaf children were always more dominant in interaction with their children than mothers of hearing children (Wedell-Monning and Lumley, 1980). There is generally an emphasis on control instruction and commands in the languages used by mothers of deaf children. These controls are due to the efforts at normal adaptation instigated by the breakdown in the processes of reciprocal communication (Brinich, 1980).

In a nutshell, whether mother's interactions with her deaf child has any decided influence on the quality of language produced and comprehended or the reduction in the impact of deafness vis-a-vis language use, it is clear that mothers/ caregivers do attempt at accommodation and that

their communicative interaction gets influenced by the deaf child's willingness and ability to participate in such interactions. As regards the impact of mother's utterances on the deaf child, there is not much dramatic change brought about by mother's interactions.

CHAPTER - III

SPEECH CHARACTERISTICS OF THE HEARING IMPAIRED

3.1. Introduction

The speech of the hearing impaired has several synonyms in literature: speech of the deaf, speech of the hard-of-hearing, dysenia, peripheral impressive disordered of language development, deaf-mutism, and audiogenic dyslalia.

There are several characteristics typical of the speech of the hearing impaired which serve to separate it from the speech of normal children. Numerous studies have been carried out to investigate the speech of the hearing impaired (Hudgins, 1934; Hudgins and Numbers, 1942; Carr, 1953; Calvert, 1962; John and Howarth, 1965; Fry, 1966; Markides, 1970; West and Weber, 1973; Oller and Kelly, 1974; Levitt, Smith and Stromberg, 1976; Smith, 1975; Monsen, 1974, 1976a,b,c, 1978; Sussman and Hernandez, 1979; Geffner, 1980; Levitt, Stromberg, et al., 1980). These studies have identified many recurring speech deviancies, thus indicating that the hearing impaired speech has a nature of its own.

Hudgins (1934), and Hudgins and Numbers (1942) were the pioneers presenting thorough investigations the characteristics of the speech of deaf children. Hudgins' 1934 study revealed five particular characteristics of deaf speech: (i) extremely slow, laboured, and excessively breathy speech; (ii) prolonged production of vowels,

resulting in either distortion or the creation of a new syllable; (iii) a tendency to devoice stops in all positions; (iv) excessive use of nasality with vowels and consonants; and (v) abnormal rhythm across utterance.

Further insights into the speech of the deaf were obtained from the study made by Hudgins and Numbers (1942). They collected the recordings of 1200 sentences from deaf pupils between 9 and 12 years. They found two general types of errors; errors involving both consonants and vowels, and errors of rhythm. The consonant errors were classified into seven general types as follows: (i) failure of distinguish between voiced and unvoiced consonants; (ii) consonant substitutions; (iii) excessive nasality; (iv) misarticulation of consonant clusters; and (v) omission of releasing consonants. The vowel errors are vowel substitutions; misarticulation of diphthongization of vowels; neutralization of vowels; and nasalization of vowels. Note that several of these are found in normal hearing children acquiring language. Several of these are found also in other speech disorders.

Nickerson (1975) has discussed the speech characteristics of the deaf under five topics: (i) timing and rhythm, (ii) pitch and intonation, (iii) velar control, (iv) articulation, and voice quality. Overall speech intelligibility, and supra-segmental errors of the deaf were discussed in a recent article by Gold (1980).

Nickerson (1975) cautioned that no two individuals whether they have hearing or not, produce speech that is exactly the same. Consequently, any description of the speech of a group is bound to fail in some respects to describe the speech of any given member in the group. This observation, of course, becomes true especially for the hearing impaired because a number of factors interact to influence the speech development in these children. Their speech development is dependent upon the age of onset of hearing loss, severity and type of hearing impairment, the

age at which the hearing loss was detected and the age at which guidance was sought for from the speech therapist and audiologist, parent's co-operation for following the therapist's advice, the amount of speech and language stimulation given to the child, sibling status, whether the child attends a normal or deaf school, whether their parents are hearing impaired or normal, factor of lip-reading, audio-visual speech reception for speech development, self-monitoring and the type of speech and language training implemented. In addition, if the child has multiple handicaps such as blindness, other physical deformities, middle ear pathology, sensorineural problems, or mental retardation, the speech development is further retarded. But most of the studies have shown that on the average the speech of the individuals with profound hearing impairment that dates from birth or shortly thereafter tends to differ in many ways from the speech of the normal children (Nickerson, 1975).

In this chapter an attempt is made to review and discuss the speech of the hearing impaired:

- Common approaches used to obtain speech samples of the hearing impaired and their analysis of the speech samples;
- Segmental errors;
- Voice aspects;
- Supra-segmental errors; and
- Overall speech intelligibility in the hearing impaired.

3.2. Methods of Collection and Analysis of Speech Samples of the Hearing Impaired

The present investigators find that almost all the studies analyzing the speech samples of the hearing impaired have used a cross-sectional approach.

Longitudinal studies of the articulatory, or the phonological development of a single hearing-impaired child or of a group are not found. The spontaneous speech samples have been collected through picture naming tasks. Imitation of the spoken word has been tested by standardized articulation tests, screening tests of articulation and photo articulation tests. Tests meant for normal children have been modified to suit the conditions of the hearing impaired. For instance, Geffner (1980) has adapted the Goldman-Fristoe test of articulation by taking out the words not occurring in the known vocabulary of 6-year old deaf children and supplanting it with other words known to exist in the child's vocabulary. While most of the tests consist of individual vocabulary items, some tests have employed sentences as well. For instance, Smith (1975) has specially constructed 20 sentences for the analysis of deaf children's speech. These sentences consist only of the vocabulary expected within the vocabulary of the deaf child of 8 years. These sentences are of different lengths and cover a range of syntactic constructions. Places of articulation employed are analyzed and sentences are so constructed that one transition from each place of articulation is at least ensured. There is also at least one transition from each of the vowels to each place of articulation. All consonants are represented in all the positions initial, medial and final positions, in consonance with such admissibilities in the language. No sound of interest is allowed to appear in an unstressed syllable and no sound of interest is allowed to appear in the initial or final word of sentence.

The analysis of the samples has been done through phonetic and phonemic transcription of the samples. In addition to perceptual judgements, voice onset time aspects, formant frequency analysis, analysis of oral air flow characteristics during the production of consonants, and the analysis of articulatory movements during speech

production have also been made. The perceptual and acoustic analysis of prosodic errors has also been made. Thus, both perceptual judgements and objective analysis have been used to evaluate the speech of the hearing impaired.

Most of the investigators have attempted to find out the significance of the errors to the overall speech intelligibility in the hearing impaired.

In our opinion, the concept of "error" is, indeed, a tricky one. An item is conceived as an error in terms of the normal language. It may also be considered as an error if there is deviancy from the linguistic behaviour generally observed in the hearing impaired population. It may also be considered as an error if the hearing impaired subject uses one item regularly, but fails to do so on occasions. In this last case the errors may be systematic or non-systematic.

With sparse language, the hearing impaired's utterances have been subjected mainly to an analysis of segmental sounds. Sequential occurrence of the segmental sounds has not been given much attention. Lexical choice, sequential occurrence of lexical items in a sentence, use of grammatical elements, etc., have not received much attention. There is a vast area of research waiting for enterprising linguists to explore. And yet research in this area will not be fruitful unless the concept of error is changed in consonance with the language of the hearing impaired - in consonance with retrieval modalities and methods of the hearing impaired. Omission, addition, substitution and distortion are not errors in the language of the hearing impaired if a consonant pattern is maintained and if there is a consistent association of objects, events, etc., with the above four categories - in other words, the sparse and special nature of the language of the hearing impaired demands a different approach from the ones we generally adopt in the identification of errors in the language of the

normals. Elision and/or holding on to one cue exclusively is an integral part of the communicative mode of the hearing impaired and this is so because of inherent constraints. Such items form regular patterns. And hence there is a need to identify, first of all, the patterns of linguistic behaviour of the hearing impaired with reference to his/her own utterances. Secondly, there is a need to arrive at a general picture of the linguistic behaviour of a group of hearing impaired individuals of similar age, linguistic background, type of hearing loss, etc. Thirdly, one should aim at a description of the deviancies in the individual hearing impaired in terms of his/her own linguistic behaviour and in terms of the linguistic behaviour of the group of which he/she is a member. Only then an insightful picture and analysis of the "errors" of the hearing impaired will become available.

3.3. Errors of Segmental Sounds

The errors in segmental sounds produced by the hearing impaired are discussed here under the consonantal errors, vowel errors, and errors involving diphthongs and consonant-vowel and vowel-consonant transitions. In General, many studies (such as Geffner, 1980) have found that vowels are produced correctly more often than the consonants. Many explanations have been offered for the higher frequency of errors reported for the consonants. One explanation is that since more consonants than vowels are generally produced in speech, there is greater likelihood of there being more errors of consonants than of vowels (Gold, 1980). However, note that the generalization that more consonants than vowels are produced may not be found valid for all contexts of the language of the hearing impaired. Another explanation given is that, since vowels carry more energy, they are easier to hear and are, therefore, produced correctly more often. A third explanation given is that vowels require less difficult tongue adjustments. A fourth explanation given revolves

around the finding that the normal ear accepts a wide range of vowel distortion and that, as a consequence the experimenters are less critical in determining the degree of vowel accuracy. A fifth explanation is stated by Monsen (1976) that the vowels, in general, convey to the listener more consonantal cues than the vocalic cues conveyed by the consonants. Therefore, he said that it is reasonable that a reduction in effects of transition from one speech sound to the next observed in the hearing impaired children results in fewer consonants being correctly produced than vowels. In other words, no hearing impaired subject demonstrates the use of all the phonemes - vowel and consonants - found in the inventory of the language of the normal hearing. We find in our study, however, that of the available consonants and vowels, the hearing impaired subjects did produce more consonants correctly than the vowels. The incorrect production of vowels was seen to be the result of excessive nasality which coloured the quality of vowels produced in many subjects. It was also seen to be the result of confusion between the heights of vowels. We found that while the part of the tongue and lip rounding were correctly handled, the height of the tongue for the vowels could not be correctly handled by the hearing impaired subjects. In our own investigation, we find that, only in the case of the partial hearing, consonants are produced more in number than the vowels. In the case of the profoundly impaired subjects, predominance of the consonants in terms of number cannot be established. In all the cases, the number of consonants was equal to that of the vowels, or in one case it was even less. Secondly, a more notable feature is that neither in the profoundly impaired nor in the partially hearing was the list of consonants or the vowels complete.

Scholars have classified the articulatory errors into addition, substitution, omission, and distortion. Many scholars have suggested that omission is the most frequent type of error in severely hearing impaired children. Several

studies (such as those of Geffner, 1980; Markides, 1970; and Morely, 1972) suggest that omission errors are more frequent in the deaf and that substitution errors are more among the partially hearing. Markides (1970) reported that the omission errors are more numerous followed by substitution and distortion. Amongst the partially hearing, substitution errors are more numerous, followed by omissions and, finally, distortions. It may be noted here that omissions also form a major part in the language acquisition of normal children. In normal language acquisition while all the four types of errors indicate in some manner and degree the types of deviancies, the process of omission reflects more insufficient acquisition of language, whereas the other three indicate more the efforts of corrections towards approximations of normal language. The fact that errors of omission are found more in the language of the profoundly hearing impaired only shows the insufficient inventory of items in the concerned language. It is also likely that an inadequate/insufficient inventory will be the chief feature of the language of the profoundly hearing impaired, whereas problems of proper use of the inventory would dominate the language of the partially hearing impaired. This fact was borne out clearly in language data of our subjects of investigation. For example, all the three profoundly hearing impaired subjects, irrespective of their varying age groups, showed an utter insufficiency in terms of the number of phonemes, both vowels and consonants. In addition to this paucity of number of phonemes, they also showed a failure to acquire phonemes, both vowels and consonants, under the various categories of point and manner of articulation. In other words, a subject not only failed to master consonants of a particular category such as stop but he failed also to master some whole categories, such as the series of fricatives in Kannada. While this was the picture presented by the profoundly hearing impaired, the partially hearing impaired acquired most of the phonemes of the inventory

of phonemes of the normal hearing. Also there was a fair distribution of these phonemes in that almost all the points of articulation and manner of articulation were found in their inventories of phonemes. However, use of these phonemes in proper positions and in acceptable combinations was at variance with the language of the normal hearing subjects and this variance is described as falling within the errors of addition, substitution, distortion, or even omission.

Several reasons have been suggested in the literature to explain why more errors of omission than other errors occur. The place of articulation of the consonant intended and the position of the consonant in the utterance seem to influence the occurrence of omission errors in the hearing impaired children. Levitt, Stromberg, Smith and Gold (1980) suggest that the consonants produced near the front of the mouth (labial and labiodental) are substantially less prone to omission errors than the consonants produced near the center or back of the mouth. Geffner (1980) has also reported that the velar consonants *k*, *g* and *ŋ*, which are not visible, are omitted in greater proportion than the more visible front consonants, namely, bilabials and labiodentals. There are conflicting findings as regards the positions in which consonants are deleted. Some studies suggest that it is the initial consonant that is deleted more frequently and some other studies suggest that it is the final consonant that is deleted more frequently. Hearing impaired subjects are seen to reduce the multisyllable words by deleting unstressed initial syllables in languages which have stress as an important meaning conveying phenomenon. Frequent deletion of the unstressed syllables and weak phonemes has been noticed. Among the nasals, omission of final *ŋ* is found more frequent in English. The deletion of final voiced consonants is more frequent than the final voiceless consonants; velar consonants seem more susceptible to final consonant deletion. In our

investigation, which was done with Kannada subjects, we found that the subjects were not motivated in several cases by the position of syllables – the deletions were done at random. In fact, in many cases, the initial syllables were retained in the partially hearing impaired. While in the profoundly hearing impaired subjects, the inventory of phonemes available to the children dictated and regulated the retention process, in the case of the partially hearing children, it is the case of production that appears to influence the retention and deletion of sounds. And yet it is, indeed, not possible for us to specify clearly what really contributes to this ease of pronunciation, since this 'ease' appears to vary from the subject to another. Of the omissions attested in our data, we could state that the initial syllables have a greater potential for retention if the sounds involved in the syllable are found in the inventory of the hearing impaired, and if these syllables are with the (non-affricate) stops, or with the bilabial nasal, or with an alveolar lateral, in that order.

The correlation of omission errors to intelligibility has been obtained by Markides (1970) and Smith (1975). Smith has reported a correlation of (-0.65) and Markides has found a high correlation of (-0.87) between the omission errors in final position and intelligibility. Gold (1980) cautions against hasty interpretations of correlations. Suppose that, of the two errors A and B, error A causes a substantial reduction in intelligibility and error B has little effect on intelligibility. But error B occurs about every time error A occurs. There will thus be a large negative correlation between error B and intelligibility. Despite the high correlation between error B and intelligibility, correction of error B will have little effect on intelligibility. The present investigators suggest that some of the following variables should be considered while correction between errors of omission and intelligibility are sought: intelligibility to whom, what is the familiarity between the

hearing impaired subject and the normal hearing, what is the content of communication, is the word familiar and frequent, what is the functional load of the content word, what is the functional load of the sound in the particular context, can not the word be retrieved through other means - by retaining some other sound cues or by signs, or by assuming/understanding it through context, and so on, what is the length of the word, what is the length of the utterance, native/borrowed status of the word and the sequences of sounds.

As already reported, the substitution errors are said to be the frequent type of error in the partially hearing children. The substitution process noticed are voicing-devoicing errors, using stops in place of corresponding fricatives, using glides in place of liquids, denasalization of nasals, fronting of consonants, and substitution between aspirated and unaspirated sounds. These findings are applicable to our data also. Nasalization of vowels, exchange of alveolar lateral for the retroflex lateral, exchange of the alveolar nasal for the retroflex nasal, likewise the exchange of a dental stop for the retroflex stop are also noticed in our data. In other words, there were substitutions of points of articulation as well attested in our data. Here also the partially hearing subjects, who alone attested these processes as a pattern, appeared to be engaged in the simplification of the production process. This raises the question whether the subjects did perceive the difference between the sounds at the acoustic levels, and whether the problem, if they have perceived the sounds correctly at the acoustic level, is related only to the difficulties with regard to production. It may be pointed out that there are similarities in the manner of production between the pairs of sounds found to be substituted in a regular fashion. This is reflected also in the acoustic level wherein one finds that the pairs fall within the same range of frequency, intensity, etc., more or less. Thus there is a

range of similarity brings about a regular pattern in the substitution process. The reasons for random substitutions are to be sought in the specific production mechanisms of the sounds involved vis-a-vis the individual abilities for such a production in the individual subjects.

Some have observed the devoicing of stops to be the frequent error while others have suggested that the voiced stops are frequently correct in the deaf children. Unvoiced plosive consonants have been seen substituted for their correspondences, substitution towards the voiced member of the pair is more common than the substitution towards the voiceless correspondence. The hearing impaired children were seen also avoiding voiced sounds (Oller and Kelly, 1974). Several reasons have been offered for devoicing found in the hearing impaired children. Smith (1975) suggested that the mistiming of laryngeal activity resulted in inappropriate devoicing in the deaf children. Gold (1980) offered hypothetical explanations for the predominance of voicing errors in deaf children. Deviant duration of the preceding vowel, he said, may affect the listeners' perception of voicing in the consonant, and that the problem of continuous phonation may result in predominance of voiced sounds. In any case, the present investigators find the evidence offered to be inadequate and controversial. In our own investigations, we find that the profoundly hearing impaired and partially hearing subjects did not show the devoicing of voiced consonants as a pattern. It is found that the subjects did not have some of the voiced consonants, but this did not amount to a regular pattern of devoicing. It may be noted that voicing is phonemic in Kannada. Secondly, there was another pattern of giving a voiced, unaspirated consonant for the voiceless aspirated consonant. This was found to be having some patterning in some of our subjects.

Fricativization of stops in the hearing impaired has been noticed by several investigators. This also is

conspicuous by its absence in our data. Fricatives in general are absent in the language of our subjects. Kannada has sibilants and glottal fricative as fricative phonemes in the normal hearing. Some investigators noticed that the final position fricatives are often substituted for by the stop consonants in English. Replacement of the liquid consonants by glide consonants in prevocalic position and by mid and back vowels in post-vocalic position in a hard of hearing subject has been reported by Oller, Jensen and Lafayette (1978). Studies report substitution of *b* for *m* and *d* for *n*. Subjects have been not only denasalizing but also devoicing the nasals. In our study we find that, whereas nasalization, which is not phonemic in Kannada, is more frequently used on the vowels, the nasals are infrequently used. There are only two nasals out of the 4 or 5 nasal phonemes, namely, the bilabial and the alveo-dental, are used in the hearing impaired language. Elsewhere it is reported that substitutions are carried out between homorganic sounds. The substitution of the frontal consonants for the posterior ones has been reported. Velar and palatal fronting, dentalization and blading, and labiodentalization of dental consonants have been reported.

Consonant cluster reduction process is another phenomenon that is observed clearly both in the literature and in our study. The hearing impaired subjects reduce the fricative-stop clusters to a stop consonant, the nasal-stop clusters to a stop, and the liquid consonant to a glide. We note, however, that our subjects did not reduce the non-identical cluster with a stop as the first member and an alveolar trill as the second member, although the trill was sometimes extremely distorted. The other processes reported are assimilation, substitution of unvoiced unaspirated consonants for initial aspirated stops, and substitution of affricates by one of its components occasionally with a voiced-voiceless error (Levitt, Smith and Stromberg, 1976; Levitt, Stromberg, Smith and Gold, 1980).

The same authors have suggested that the deaf children place their articulators in roughly the right place, but the consonant substitutions appear to involve errors in timing and control, such as improper velum control, and inappropriate voicing or lack of voicing. We find in our data that our subjects were influenced more by the manner of articulation in that they retain the manner but change the point of articulation.

As already stated, only a low proportion of distortion has been reported in the deaf children. Distortion is generally a sort of co-articulation process indulged in by the hearing impaired. Distortion in our study was found more frequently as regards the trill sound, and the sibilants in the case of the partially hearing. Distortion to some extent was also noticed with regard to the affricates and retroflex sounds.

Almost of studies indicate that, for both partially hearing and deaf subjects, errors involving the final consonants are more numerous than the errors involving initial consonants: Omissions are more frequent in the final position. The deviations are also more often in the final than in the initial and medial positions. These were borne out in our study also. However, in the initial positions, the occurrence of omission was found more frequent if the sounds involved happen to be fricatives including sibilants and retroflex sounds. Also omission in the final positions have to be linked with the ability of the hearing impaired to produce multisyllabic words and longer sentences. We found that, when a word had only a single syllable or is of a disyllabic structure, the final sound is not usually omitted; it could, however, be substituted or distorted. Geffner (1980) reported that the proportion of correct production of consonants in the initial, medial and final positions were 0.30, 0.22 and 0.19 respectively. Her analysis indicated that the errors of omission are greater for final consonants (0.77) than for the initial consonants (0.61). Errors of substitutions

which constitute a minimal percentage are greater for initial position (0.08) than for the final position (0.02).

West and Weber (1973) have found no relation ship between errors involving place of articulation to hearing abilities or speech intelligibility. The poorest groups in speech intelligibility made about the same proportion of place errors as the best. A multiple regression analysis made by Levitt, Stromberg, Smith and Gold (1980) on the relation between percentage of intelligibility and different error types of different word positions indicates that the errors involving phonemes in the initial or medial positions carry considerably more weight than the errors involving phonemes in word final positions. Note that all these are relevant to and found in the use of language by the normals. For instance, the initial and medial consonants/vowels would have already set the cues for a particular word, since the succession of sounds in a word carries in it the cues for the recognition of a word. Even before a word is fully pronounced, we are able to recognize what the speaker has attempted to produce. In other words, the final sounds have, in most cases, less value for the recognition of the word attempted. The present authors find that, in arriving at the weightage, adequate attention has not been given to minimal pairs. Where minimal pairs occur in an utterance, the weightage for the position in which the pair of contrasting phonemes occurs will be different from the normal weightage found for that particular position. This is valid equally for the language of the hearing impaired.

Several studies have discussed the order of emergence of the place and manner of articulation of consonants and the acquisition of correct consonantal production. Irwin (1947 and 1948) reported that the back consonants appear first in the normal infant's speech. Carr (1953) studied the spontaneous speech sounds of 5-year old deaf born children. The vowel and consonant sounds in

these children did not continue much beyond the level of hearing infants from 12 to 13 months. The data revealed that the front consonants were used by these children more often than the back consonants. According to Carr, this was in agreement with the early rehabilitators of the deaf, who had suggested that the front consonants are the first to be taught. West and Weber (1973) found that, in their four-year old hard of hearing subject, frontal consonants were better established than the posterior consonants. They also found that voiced consonants requiring back lingual placement were seldom used. Smith (1975) reported that the consonants with a bilabial place of articulation headed the list of correct productions, followed by all glides and i, v and n. Stops in alveolar and velar region, h and the linguadental fricatives succeeded. Greater frequency of errors were reported for velar nasal, and alveolar and palatal fricatives in that order. Affricates had greatest proportion of errors in Geffner's study. She has also given the proportion of correct production of consonants classified on the basis of manner and place of articulation. Geffner's conclusion is to be noted: the visibility of phonemes proves to be an important factor in the spontaneous ability to produce speech.

Our study was not a longitudinal one; it was conceived to be a cross-sectional study focusing on the age and type of hearing loss as the major variables. We originally assumed that a cross-sectional study of the language behaviour of the hearing impaired may also bring out possible hierarchies of language elements in the language acquisition process, as found valid in the study of normal subjects. However, it soon became apparent that the behaviour of the hearing impaired was so diverse from one another that cross-sectional study will not yield any hierarchy. In a way, this finding leads us to doubt whether, in view of the diversity in individual language behaviour of the hearing impaired subjects, we could work out detailed

hierarchies of the emergence of linguistic units in the hearing impaired population. It is also to be checked whether this position is not valid for all language disorders in general. That is, while it is possible to identify the overall types and general characteristics which define a disorder, it may be difficult to work out strict hierarchies of emergence of language units, as done in the case of normal language acquisition. We find in our observations that, while it is possible to conclude that in the case of the deaf subjects the earliest consonants or vowels to emerge are those whose production is more clearly visible (frontal ones), the position that this is in contrast to the earliest emergence of sounds in the normal learning children cannot be agreed to in full. This is so because there are complicating evidences in the normal language acquisition. For example, Jakobson (1971) proposes the priority for bilabial sounds. This partially supports the statistical universals proposed by Greenberg (1963). Moreover, in most studies, a strict hierarchy between the front and back sounds cannot be maintained.

In general, the studies reveal that the labials and labiodentals are the more correctly produced consonants, and the alveolars, palatals and velars are prone to be produced more incorrectly. Though the glottals are not visible, they are more correctly produced than the other back sounds. When the consonants are classified accordingly to manner of production, the laterals, glides, and stops head the list of correct production, and the fricatives, nasals and affricates follow them.

Vowel Errors

As already reported, investigations have shown that vowels are produced correctly more often than the consonants. However, even vowels undergo certain changes in the language of the hearing impaired. These errors include substitutions, diphthongization of vowels,

nasalization of vowels, and durational distortions of vowels. The findings in the area of vowel errors committed by the hearing impaired are listed below: (most of the findings are on English speaking hearing impaired subjects).

1) Vowel substitutions in the hearing impaired children are said to be typically towards a more central vowel (Angelocci, 1964; Levitt, 1972; Levitt, Smith and Stromberg, 1976; Smith, 1975; Levitt, Stromberg, Smith and Gold 1980)

2) All Vowels are substituted by the vowel ∂ fairly often (Smith, 1975); Levitt, 1972; Levitt, Stromberg, Smith and Gold 1980) and by Λ slightly less frequently (Smith, 1975).

3) Greater the closeness between the heights of the vowels, greater is the mutual substitutability between them (our own investigation).

4) Hudgins and Numbers (1942) found that vowel neutralization contributed to 19% of the total errors.

5) Diphthongization is the least common mistake made by the deaf and partially hearing subjects (Markides, 1970; Levitt, Smith and Stromberg, 1974). It seldom exceeded 1% of the time (Levitt, Smith and Stromberg, 1976).

6) Excessive nasalization has been noticed in many hearing impaired subjects.

7) Both the absolute and relative duration of vowels is distorted in hearing impaired children.

8) The deaf achieve vowel differentiation by making excessive laryngeal variations with only minimal articulatory movements (Angelocci, Kopp and Holbrook, 1964).

9) The errors in placement, when they occurred, tended towards the more neutral position. This is related to the point made under item (1).

10) Levitt, Smith and Stromber 1976) interpreted from their deaf subjects that the placement of articulators by their subjects is in roughly the right place. But the aim is not perfect.

11) The front vowels are used more often than the back vowels (Carr, 1953; and West and Waber, 1973). The low vowels are more correctly produced than the higher vowels (Geffner, 1980).

12) Substitutions from a diphthong to one of its components is common in the deaf subjects.

13) The deaf drop more commonly the second component of the diphthong while at the same time prolonging the first component (Markides, 1970).

14) Creation of two syllables and reduction of diphthong to a single vowel are the two ways in which the deaf subjects manifest the error (Hudgins and Numbers, 1942).

15) We found in our investigations that substitution among the short vowel and its counterpart is found more often; the long vowels are generally substituted by their short vowels.

16) u and i are said to have greater stability in the organic formation, which implies that they are more consistently recognized by the listener (Geffner, 1980). In Geffner's study, the deaf showed some indication that these "stable vowels" are produced correctly more often.

17) Diphthong errors constitute for 55% of the total errors (Hudgins and Numbers, 1942).

18) Auditory discrimination of the vowels by the normal listeners is different from that produced by the hearing impaired. This is attributed to the domination of the visual cues in the phonemic systems of the deaf.

19) Vowel neutralization seems to be greatest for back and open vowels.

20) While the profoundly hearing impaired subjects do not master the entire inventory of vowels in the language of the normal hearing, the partial hearing subjects are found to have more difficulty in mastering the patterns of usage of vowels, our data revealed.

21) As we pointed out in the earlier chapter, out data indicates that both the profoundly hearing impaired and the partially hearing subjects do not ever substitute a consonant for a vowel or vice-versa.

22) Both the profoundly hearing impaired and the partially hearing subjects do not exhibit mastery of the allophonic patterns of the vowels found in the normal hearing populations. (This was based on our observation of some Tamil speaking hearing-impaired subjects.)

3.4. Consonant-Vowel and Vowel-Consonant Transitions in the Hearing Impaired

In speech utterances, sounds are not produced as isolated entities. They follow or precede other sounds and, in their occurrence, the sounds influence one another in points of articulation and/or manner of articulation. Moreover, phonetic realization of phonemes is one area in which several peculiarities may be noticed in a language. Apart from the mutual influence based on points and manner of articulation, which may be progressive or

regressive, coalescence of two sounds may also take place, leading either to the deletion of one sound and retention of the other, or substitution of a sound not related in any manner. There are certain universal constraints. From the universal constraints and universal sets, individual languages draw their own peculiar combinations. Not all these aspects have been studied in the language of the hearing impaired. Most of the studies undertaken so far concentrate on the consonant-vowel and vowel-consonant transitions; in other words, neither the allophonic distribution nor an in-depth study of the assimilation /dissimilation/ coalescence processes have been undertaken. Because of inherent constraints in eliciting exhaustive data, and because of the better efficacy of physical analysis, the investigators have often resorted to spectographic and electromyographic investigations to study the transitional aspects.

Investigators find that deaf speakers exhibit difficulty in coordinating articulation with phonation. Rathman (1976) finds that normally occurring co-articulation effects are minimized in the deaf. Rothman finds that the transitions from one sound to another in the speech of deaf speakers have a restricted range and a slower rate of movement than in the speech of the normal speakers. Further, the deaf group manifests articulatory stereotyping - that is, they tend to start each articulatory sequence in much the same way as they do any other, regardless of the context. Monsen (1976) finds reduced second formant transitions both in time and frequency in the hearing impaired. Monsen concludes that since the formant transitions are important acoustic cues for the adjacent consonants, reduced second formant may be an important factor in the low intelligibility of the speech of the deaf. If we assume that vowels, in general, convey to the listener more consonantal cues than what vocalic cues the consonants do give, then it is reasonable that a

reduction in the effects of transition may result in fewer consonants being correctly produced than the vowels.

Rathman's (1977) study finds that the deaf group, in contrast to the normal groups, (i) extends the duration of the intervocalic stop closures and the duration of the individual phonemes, (ii) exhibits difficulty in coordinating articulation with phonation, and (iii) exhibits greater interspeaker variability. Smith (1975) finds that the transitional process generally reveals a process of insertion. This happens because, according to Smith, the tongue is moving toward or away from the correct position but too slowly. Smith finds that the sequence of vowel and fricatives are produced as vowel, stop and fricative, and the fricative vowel sequence is produced as fricative, stop and vowel or as the fricative, glide and the vowel. Thus, Smith's study reveals the insertion of another consonant during the consonant-vowel and vowel-consonant transitions.

The present investigators suspect that, while the process itself may be commonly found among subjects of diverse language groups, the choice of the particular items for insertion may differ from language to language and from individual to individual. The closeness or otherwise between the sounds occurring in succession in terms of points and manner of articulation, the length of the utterance, the number and variety of sound units, complexity of phonological structure, the functional value of the sounds involved vis-a-vis the communicative content appear to influence the choice of elements for insertion. For example, in our investigation, there were at least two types of insertions noticed. The first type of insertion was found both in the normal hearing and hearing impaired subjects - vocalic release at the end of a word and between clusters. The second type of insertion was peculiar to the hearing impaired subjects. In the profoundly hearing impaired subjects, pauses between the consonants that constitute a cluster were dominant. Also, these subjects inserted a

vocalic release, nasalization and slurring, apart from some consonant or the other between the consonant clusters. The consonant thus inserted cannot be accounted for by any phonological conditioning.

Rothman (1976) suggests a change in focus. A primary emphasis, Rothman argues, on teaching the deaf speakers the correct articulation of individual sounds without accounting for the effects of context on phonemes, syllables and words would result in faulty speech production. Rothman emphasizes that the rules describing (allophonic) phoneme variation due to co-articulation and context should be established and incorporated into early oral speech training programmes for the deaf. The rules so established should always relate to the speech process as a dynamic synergistic event determined by inter-relationship of phonemes in the context. Rothman's suggestion is linguistically motivated. The goals of therapy, however, cannot be only based on linguistic description of normal language. The type of hearing loss is an important factor in deciding on whether allophonic distribution should be part of therapy.

3.5. Suprasegmental Errors

Studies on normally hearing children have shown that early communication is largely suprasegmental, as discussed in Chapter-2. In contrast, the hearing impaired children stop or regress in their vocal behaviour in the age at which suprasegmental production gets differentiated in a normal child. Generally speaking, suprasegmental production precedes segmental production in a normal child. But, the hearing impaired may start imitating both the aspects at the same time during the speech training sessions. As Ling (1976) suggests, if the residual hearing in low frequencies is good, then the sequence of development of segmental and suprasegmental features may be normal.

Relatively less attention has been given to the analysis of suprasegmental errors in the hearing impaired children. The studies on suprasegmental errors are discussed here under intonation, stress and quantity.

Intonation

Since intonation contours carry meaning, they must be morphemes according to Bloomfield (1933). Since the intonation contours are determined by various pitches, he said, they must also be phonemes. In our investigation, we find that intonation is characteristically absent or imperfect in the deaf. And this is clearly in consonance with the picture of segmental phonemes in the language of the hearing impaired. Restricted range of pitch variation has been reported by Stark and Levitt (1974). Levitt, Smith and Stromberg (1976) found that the most common suprasegmental errors, as reported by the judges, are inappropriately monotonous rate, insufficient or excessive variability of intonation, inappropriate stress, and spasmodic control of phonation. Stark and Levitt (1974) examined the inter-relationship between reception and production of stress, intonation for Yes-No questions, and location of pausal juncture. They hypothesized that significant information is contained in lower frequencies which may be within the range of residual hearing of deaf children. However, the study revealed poor performance in both reception and production of prosodic features, the highest error rates occurring for the intonation feature. In other words, it is not the availability of frequency range supposedly involved in the perception of intonation that determines the perception of intonations. It appears that something more than the frequency range is required. Perhaps, something related to cognition is involved here.

Susman and Hernandez (1979) tested the intonation control in ten hearing impaired subjects. The subjects read three sentence pairs, each having a declarative and

interrogative form. Terminal drops in means fundamental frequency were found for both sentence types. Phillips, Remillard, Bass and Provonost (1968) had earlier suggested that a terminal pitch rise may be more difficult for a deaf child to produce than the terminal fall.

Levitt and others (1980) reported that the deaf use durational cues in place of intonation. In many Indian languages including Kannada, durational cues get merged with intonation cues. For example, the interrogative intonation is formed by adding -a: to the sentence final word. In such cases also, the profoundly hearing impaired had difficulty in maintaining the length of the vowel, whereas some neutralization was noticed in the case of the partially hearing subjects. This is in keeping with our earlier statement that the hearing impaired subjects had difficulty with maintaining vowel length.

We found in our investigation that the hearing impaired children appeared to use idiosyncratic durational cues contrastively between questions and statements, in the absence of consistency in maintaining vowel length. Note that normal hearing children also go through similar stages at earlier ages. However, the normal hearing children to ultimately acquire consistency in maintaining the length for negative interrogation, whereas the hearing impaired do not.

Nickerson (1975) had earlier suggested that the deaf speakers who tend to produce each syllable of equal duration may also generate a similar pitch on each syllable.

Recently Indira (1981) analyzed and compared the intonation patterns of 4 normal hearing and 4 hearing impaired subjects. The subjects read two simple stories in Kannada, each of which depicted the primary emotions - fear and anger, and joy and sorrow respectively. The equipments for the acoustical analysis included the Beat frequency oscillator, pitch analyzer, measuring amplifier,

and the level recorder. It was found that the hearing impaired subjects did not have the same rise and fall patterns as normal hearing subjects. The pitch variations in the hearing impaired was also relatively restricted when compared to normal subjects. An additional finding was that the duration of the speech segment was more in the case of the hearing impaired subjects. (Note this is in conflict with our statement made earlier.) It was suggested that this factor would have been the reason for the little changes in the intonation patterns observed in the hearing impaired subjects. In contrast, the normal hearing subjects showed sharp changes in intonation patterns.

In short, it has been reported by various researchers that the intonation control in the hearing impaired subjects is not adequate. Restricted or excessive pitch variation, gradual pitch variation, and the use of durational cues in the place of intonation feature are some of the deviancies described so far.

Several explanations have been reported for the deviant intonation patterns. It is well known that pitch is primarily an auditory domain. Phillips, Remillard, Boss and Provonost (1968) said that the lack of intuitive grasp of the concept of pitch by the deaf may result in their attempts to raise their pitch by increasing the intensity. But Ling (1966) has suggested that the residual hearing need not be extensive for this purpose. Still others have claimed that the attempts to increase the amount of proprioceptive feedback by the hearing impaired speakers result in excessive pitch variations. In contrast, Nickerson (1975) has hypothesized that the excessive pitch variations in the deaf is the result of inappropriate muscles or muscle groups in controlling vowel articulation. These inappropriate muscle contractions may result in inadvertent tensing or slackening of the vocal cords, resulting in greater than average pitch variations.

In our own investigations we find that performance of intonation is related to severity of loss. A monotonous utterance is the general rule, with variations depending upon the severity of the hearing loss. Our tool covered information on intonation in its last section where a free narration of a story was elicited from the subjects. Out of the total of 11 subjects, only 4 responded to this. The narrations were faulty and did not contain clear-cut distinctions between various intonations - only a monotonous note was discernible. However, the intonational content could be appropriately conveyed through facial and hand gestures.

Stress

In general, the stressed syllables have a higher fundamental frequency, greater intensity and a longer duration than the unstressed syllables. Nickerson, Stevens, Boothroyd and Rollins (1974) measured the duration of syllables in four short utterances read by 25 deaf and 25 normal hearing children. The results revealed that the deaf children failed to produce the durational differences between the stressed and unstressed syllables. The deaf subjects produced the unstressed syllables with increased duration.

Susman and Hernandez (1979) selected ten hearing impaired subjects, to determine the subjects' ability to control stress. Each subject read consecutive CV syllables and he was instructed to place stress on one syllable within each trail. In addition, five noun-verb pairs were embedded in carrier sentences to test the subject's ability to place correct stress in continuous speech. Group means indicated a slightly higher fundamental frequency for stressed syllables in insulation, but the difference was small and statistically not significant. In the noun-verb pairs spoken in sentence format, in contrast to the performance in the production of nonsense syllable, the subjects did not

consistently produce higher intensity or frequency levels for the stressed syllables. Four subjects showed the reverse tendency. The intensity of the unstressed syllables exceeded that of the stressed syllables.

Mc Garr (1976) reported that the hearing impaired subjects place equal stress on all words. None of the researches cited above, studied all the three aspects of stress in the hearing impaired. Failure to produce the difference in duration between the stressed and unstressed syllables, greater than normal duration of the stressed vowel when a derivational suffix is added to the base word, omission of the unstressed syllables, insignificant or absence of increase in frequency or intensity while producing stressed vowels are some of the deviancies reported. Therefore, as far as duration is concerned, it is prolonged for both stressed and unstressed syllables. This lack of differentiation between length of stressed and unstressed syllables contributes to the listener's perception of improper account or stress in the speech of the hearing impaired (Gold, 1980). Placement of equal stress on all words, while reading, may add to the monotonous speech production problem in the hearing impaired.

In most of the Indian languages, stress is not phonemic. It is found to occur in sentence initial position, perhaps with the function of separating one sentence from the other. In many languages stress is placed on words that require to be focused. This generally happens in languages wherein the word order is not rigid. Our problem, then, should be to investigate how the hearing impaired separate one sentence from another and how they focus on significant words. While the speech of the partially hearing has fluency, the speech of the profoundly hearing impaired is generally of a faltering type. In both the cases, however, there are more pauses between words noticed than in the language of the normally hearing. There are also more number of elliptical sentences than found in the language of

the normally hearing. One sentence is seen separated from another based on the familiarity the hearer has with the context. Another important factor in this regard is the lengthened pause between sentences in some subjects. Whether the increase in duration of pause is a significant factor to isolate one sentence from another in a stretch of utterance in the profoundly hearing was tested impressionistically by the project investigators by asking two normally hearing subjects. These two felt that the pauses, indeed were longer between two apparently different sentences in a stretch of utterance. However, this judgement could also be motivated by an imposition of their implicit knowledge of sentence structure in Kannada on the utterances of the hearing impaired. In any case, the duration and placement of pauses in the utterances of the hearing impaired were seen to be different from those of the normally hearing. Another important feature was the slurring phenomenon. both the profoundly hearing impaired and the partially hearing subjects tended to slur the syllables usually after the second syllable in a word and almost the entire word in the final position in an utterance. This was in addition to simplification and reduction of syllables in the words uttered. This was, however, not the case with those adults who became deaf or partially hearing in later life. Slurring of syllables and the retention of syllables of a word are two different processes. Whatever be the syllables of a word retained, the slurring does take place as per the rule stated above.

Length

The duration of sounds may be conditioned by the following factors: point and manner of articulation of the segment itself, preceding and following segmental sounds, suprasegmental factors (especially stress), and position of the sound within a higher level of phonological unit. Duration may function as an independent variable at word level (quantity) and sentence level. A thorough

investigation of all these factors has not been done in the hearing impaired subjects.

Lehiste (1970) has said that the physiological mechanism that is ultimately responsible for the quantity phenomenon is the process involved in the timing of articulatory movements.

Calvert (1962) found that the deaf speakers typically distort absolute and relative vowel duration. Monsen (1974) studied two aspects of vowel duration: the inherent durational differences between the two vowels *i* and *I* and the modifying influence of the following consonant. In the deaf subjects, the two vowels occupied much more to create durational ranges. The subjects tended to create mutually exclusive durational classes for the two vowels. The duration of one vowel could not approximate that of the other even when they occurred in the presence of different consonants. The absolute durations of the two vowels in normals overlapped if the accompanying consonants differed.

Studies by Whitehead and Jones (1977) revealed that the severity of hearing loss is an important factor that determines the ability of the hearing impaired children to control vowel duration. The oscillographic analysis revealed that for normal hearing and moderately hearing impaired subjects, a significant difference in vowel duration occurred between voiced-voiceless, and between plosive, fricative consonant environments. But, for the deaf subjects, however, there was no significant difference in vowel duration for any of the consonant environments. The study by Susman and Hernandez (1979) revealed that the performance of the hearing impaired subjects conformed to the normal group by producing longer vowels before the voiced stops than before the voiceless stops.

Reily (1979) investigated the absolute and relative vowel durations with respect to type tense-lax feature,

lexical stress, pre-pausal pattern and sentence final lengthening. The absolute duration of vowels produced by the deaf subjects was two to three times longer than that produced by the hearing group. But the relative vowel duration with respect to the vowel type, tense-lax feature, lexical stress, and sentence pattern conformed to the normal patterns. It was found that the relative duration of vowels was closely related to intelligibility but the absolute duration of vowels was not.

Thus, most of the studies indicate that the absolute vowel duration is distorted in most hearing impaired subjects. But controversial result have been reported with respect to relative vowel duration in varied consonant environments. Whitehead and Jones (1977) reports indicate that, the more profound the hearing impairment, greater is the chance of relative vowel duration being distorted. Further, the relative vowel duration, rather than absolute vowel duration, is related to intelligibility.

Prolonged duration has also been reported for consonants. Whitehead and Jones (1978) suggested that the hearing impaired make use of the residual hearing to develop consonantal durational patterns similar to those of the normal-hearing population. In contrast, the deaf do not learn to combine phonemes and view them as dynamic articulatory events; rather, they view speech in terms of distinct individual phoneme units. Therefore, both the absolute and relative consonant duration are distorted in the profoundly hearing impaired population.

In Kannada there are long vowels and long consonants (taking all identical clusters as single units). The tool we administrated took into account all the long vowels and their consonants both with their corresponding short vowels and other long vowels. We found that there is a qualitative difference between the vowels of the hearing impaired and the normal hearing in terms of number, and manner of production. First of all, not all the vowels are

acquired by the congenitally hearing impaired subjects. Secondly, there was a qualitative difference in the height of the vowels produced in words. For example, the *i* was always either longer than the normal hearing sound or more tense. Thirdly, the long counter parts of the short vowels, rather the pair of short-long vowels, was not found for all the vowels acquired, in the case of the congenitally hearing impaired children, whether profoundly impaired or partially hearing. A chief characteristic was that the corresponding short vowel found in the normal hearing and the long vowels of the normal hearing were not produced appropriately. Thus performance with vowels was found to be deficient both in terms of their number and quality of production. Another important point noticed was that frequently the vowels are nasalized was opposed to non-nasalization in the language of the normal hearing.

3.6. Speech Characteristics Identified in Instrumental Analysis

Voce onset time (VOT) characteristics of stop consonants (Monsen, 1976), oral air flow characteristics during the production of stop consonants and fricatives (Whitehead and Jones, 1978; and Wirz, Subtelny and Whitehead, 1980) and electromyographic investigation of articulatory movements have been investigated in the hearing impaired children. These studies are reviewed in brief here.

The start of vocal fold vibration in relation to the noise burst or some other articulatory event is referred to as voice onset time or VOT (Fry, 1973). It serves as an important cues for the distinction between voiced and voiceless phonemes. Monsen (1976) stated that because the deaf child constructs a linguistic code by means of cues which are acoustically different from those available to the normal hearing child, his linguistic system may also be different from the normal in some proportionate degree.

The results of his study revealed that: (1) Some deaf subjects produced the distinction between voiceless aspirated stops and (voiced) unaspirated stops in the same way as do the normally hearing subjects. (2) The deaf subjects who failed to produce the voiced-voiceless distinction have a tendency to produce what appears to be a single phoneme for both stops, and this single phoneme tends strongly to be the unaspirated member at the labial and alveolar places of articulation, and to be either the unaspirated or the aspirated member for the velars. (3) Both the normal subjects and those deaf subjects who produced the voiced-voiceless distinctions appropriately, did produce the stops whose point of articulation is further back in the mouth to have the longest interval between the release and the onset of voicing. However, it was interesting to note that this same tendency was also found for the deaf subjects who failed to produce a normal distinction during the production of voiced and voiceless stops. It was also found that the exact place of articulation of the stop may be different from the position used in the language of the normal hearing. The tendency for a deaf child to vary the place of articulation is greatest where there is physiologically the most space for variation: least variation is to be expected for the labials and the most for the velars.

In our investigation, we find that the subjects did not make any distinction between the aspirated and unaspirated sounds. In some stray cases, some sounds were produced with aspiration. Such an aspiration was found usually with the velar voiceless stop. Aspiration is not normally used in the everyday speech of Kannada. However, for stylistic and sociolinguistic reasons, aspiration is used even in normal everyday Kannada, even as it is phonemic in learned/deliberately acquired Kannada. Thus, since the occasions in which aspiration is phonemic are not generally accessible to the hearing impaired, it is not surprising that the speech of the profoundly hearing

impaired and the partially hearing does not have aspiration as a pattern. However, voicing is phonemic and voicing is utilized in the production of Kannada consonants in the language of the hearing impaired. And yet there is no neatness to pattern maintained in the language of both the profoundly hearing and the congenitally partial hearing subjects. That is, not all the voiceless consonants, which have their voiced counterparts in the normal hearing language are found to have their voiced consonants used in the sparse language emitted by the profoundly deaf and the partially hearing populations. That is, in addition to the fact that the language of the congenitally hearing impaired children does not have all the consonants found in the language of the normal hearing, the subjects exhibit a lack of pattern among the sounds available to them.

Whitehead and Jones (1978) measured the peak rate of oral airflow during the production of plosive consonants in 5 normally hearing, 5 moderately to severely hearing impaired, 5 profoundly deaf adult males. The airflow was measured during the production of CV and VCV syllables. All the subjects were able to intelligibly produce the syllables. The results indicated that for the normally hearing and hearing impaired subjects, in both syllable environments, the voiceless plosives were characterized by significantly greater oral airflow than their voiced counterparts. However, the results for the deaf subjects were not consistent with those for the normally hearing and hearing impaired.

Wirz, Subtelny and Whitehead (1981) indicated that for all the groups of subjects (normal) hearing, profoundly hearing impaired and partially hearing impaired, in both syllable environments, the voiceless sounds (fricatives) were characterized by greater air flow than their voiced counterparts. In deaf subjects, however, the average individual flow rates for each of the four fricatives were significantly greater in the CV context and significantly less

in the VCV context, when compared with normal hearing and hearing impaired subjects. In short, the profoundly hearing impaired subjects did not conform to the normal hearing group during the production of plosive consonants, even though they were capable of producing them intelligibly. During the production of fricative consonants, the syllable environments seem to be a factor, which is not so in the normal hearing group. The moderately to severely hearing impaired subjects, on the other hand, conform to the normal group in oral airflow characteristics.

Deviant articulatory movements during the production of consonants in the hearing impaired have also been sought and identified. Lever and Sievers (1976) studied four normal and 11 deaf subjects. The test consisted of 10 single words (CVC type) and three sentences with typical intonation patterns. Investigation using the X-rays, Kinemascope and picture synchronized tone recording revealed three types of articulatory deviance: a deficient deviations in tongue movements, very slight movement in the pharynx area, and adoption of a tongue position peculiar to each subject.

Huntington, Harris and Sholes (1968) compared the articulatory movement in the normals and deaf speakers. The electrodes of the electromyogram were placed on some diagnostic location on the facial and tongue musculature, and the patterns of contractions were measured for eleven consonants spoken in a disyllabic frame. The results showed that the patterns of facial muscle contractions of the deaf speaker are in general exaggerated. On the other hand, the tongue muscle patterns of the deaf speakers were stereotyped, but were frequently wrong, and there was no consistent pattern in direction of errors. Although they found that the deaf were more likely to produce a consonants correctly if they had a visual model to follow, they suggested that visibility itself was not the crucial factor determining why the bilabial sounds were more often

correct than other consonants. They proposed that tongue movements were actually harder than lip movements, and therefore, lingua-alveolars, lingua-dentals and lingua-velars would be hard to produce.

The interpretation made by Huntington, Harris and Sholes is consistent with Geffner's (1980) findings. Geffner's study revealed that the linguadental, palatal, alveolar and velar had the least proportion of correct production. The study also revealed that the glottals are produced correctly more often than the lingual consonants. Note that Geffner's (1980) hypothesis that the visibility of consonants was an important factor for correct production of consonants does not explain the glottals being produced correctly more often than the lingual consonants.

Though Huntington, Harris and Sholes (1968) have concluded that tongue movements are harder in deaf children, it may not be the ultimate cause for the poor utterance of lingual consonants. Inappropriate auditory and speech perception of these consonants may still be the major factors. It is also probable that the glottals are perceived with less difficulty through the tactile modality, and are hence produced correctly in a relatively greater frequency.

Fundamental Frequency Characteristics

It is well known that the fundamental frequency lowers as one moves from childhood through adolescence and then to adulthood. This is said to require some acoustic monitoring (Boone, 1966). Boone stated that the voice of deaf children of 7 to 8 years is not higher than the normal group. But, as the deaf children grow older, they do not necessarily develop the lower voices of the normal post-adolescent. The deaf child or adult, who lacks auditory feedback, appears to need some external guidance in using the acceptable pitch levels of this age group.

Some investigators have reported higher fundamental frequency in their deaf subjects. Engelberg (1962) reports that the falsetto voice is said to be the result of most vibration of the most anterior segments of the vocal cords. Anagelocci (1964) also found higher fundamental frequency in deaf subjects in their spectrograms.

Gilbert and Campbell (1980) reported the following: As the hearing impaired children become older, they may be exposed to more auditory training and they may use auditory cues to lower the fundamental frequency. Secondly, the growth of the laryngeal mechanism in both males and females may over-ride the auditory feedback deficit and reduce the fundamental frequency. Thirdly, the emphasis on speech and auditory training in oral communication schools may contribute to the speaking fundamental frequencies which are chosen by the normally hearing population than reliance on the total communication process. In Collins' (1979) study the subject was fitted with an experimental hearing aid which transposed the sound upward in frequency to the range she hears best. Analysis of the vowels i, a and u in sentences in the aided and unaided condition revealed a systematic downward shift in the fundamental frequency in the aided condition. The study reveals the importance of auditory monitoring for pitch control.

Loudness

Not much has been reported on the loudness dimension of voice in the hearing impaired children. It is well known that the loudness of a voice is determined by the pitch of the voice. This may be the reason why the researchers have concentrated their attention to evaluate the pitch rather than the loudness dimension in the hearing impaired.

Voice Quality

The most frequent quality deviation reported in the hearing impaired is excessive nasality (Hudgins and Numbers, 1942; Sherman, 1952).

Some investigators have reported that, in general, the deaf speakers are perceived to be more nasal than the normal speakers. Further, the deaf speakers are perceived to be more nasal when speaking at a reduced tempo than when speaking at a normal tempo. They concluded that much of the nasality perceived is the natural consequence of the reduced speaking tempo rather than due to the velopharyngeal dysfunction. The tendency of the speakers to break the velopharyngeal seal when their rate of speech is reduced was an explanation offered for the perception of nasality in the speech of the hearing impaired.

Stevens, Nickerson, Boothroyd and Rollins (1976) have investigated nasality in deaf children using an accelerometer attached to the nose. The accelerometer was in turn connected to a visual display. They found that 76% of the subjects had excessive nasalization in at least half the vowels in monosyllabic words and 36% of the subjects nasalized at least 8 of the 10 vowels tested. Fletcher and Daly (1976) concluded that, in contrast to Colton and Cookers' findings, the rate of speaking was not significantly related to the nasalance scores in the hearing impaired subjects. Boone (1966) suggested that the nasality in the deaf subjects is due to cul-de-sac resonance. The cul-de-sac resonance in this population is the result of retraction of the tongue towards the pharyngeal well instead of placing it in a normal, more forward and higher position.

According to Nickerson (1975), learning velar control is difficult for the deaf children for two reasons: (1) raising and lowering the velum is not a visible gesture and is, therefore, not detectable by lip-reading, and (2) the activity of the velum produces very little proprioceptive

feedback. Further, the movement of the velum must be timed accurately when producing words with abutting nasal and stop consonants if the appropriate sounds are to be produced and if the resulting speech is to be produced and if the resulting speech is to be fluent. Tense or harsh voice is another deviant voice quality reported in the deaf (Whitehead and Bancroft, 1979; Wirz, Subtelny and Whitehead, 1981). Thus, hypernasality, harshness, and breathiness are the deviant voice qualities reported in the hearing impaired children.

A study by Seaver III, Andrews and Grants (1980) has indicated that the hearing impaired subjects do not have a deficiency in the anatomical structure needed for the velopharyngeal closure.

In India, so far the assessment of the speech characteristics of the hearing impaired has not included instrumental analysis. In fact instrumental analysis and experimentation of the speech of the hearing impaired using Indian languages has begun in the National Institute for the Hearing Handicapped at Bombay and the All India Institute of Speech and Hearing in Mysore. Neither the deaf schools nor the individual privately practicing speech therapists show much interest in these aspects. The Departments of Linguistics have their own priorities which do not include practical applications and descriptions of the present sort.

3.7. Rate of Speech Production

The rate of speech production in the hearing impaired is said to be slower. The normal subjects produce 3.3 syllables per second (Pickett, 1968) but the deaf produce 2.0 syllables per second (Nickerson, Stevens, Boothroyd and Rollins, 1974). Thus, according to the above authors, the overall speech rate is termed slow in the hearing impaired subjects. The reduced speech rate could be due to the factors discussed here: excessive absolute duration of

vowels and consonants, the distorted relative durations of vowels and consonants and hence of the difficulty in making smooth transitions, insertion of more pauses, pauses inappropriate places and prolonged pauses. In addition, long duration of stressed syllables may also contribute to the slow speech rate in the hearing impaired subjects. The review suggests that problems in phonatory-respiratory control resulting in a production of short duration of breathy voice, and deviant timing of articulatory movements may be contributing to the errors. Emphasis of the teachers on isolated phoneme production by the deaf may also be a contributing factor for the reduction in speech rate in the hearing impaired speakers.

3.8. Other Features

Investigations have generally ignored several features of speech and focused on items we have dealt with above. Some of these omitted features are length of sentences, use of juncture, features that mark one sentence from another, and features of discourse. Our investigations partly focused on these elements. The results of our findings are as follows:

(i) Length of Sentences

The profoundly hearing impaired subjects produced only sparse language data. The data consisted only of 'broken' sentences - mostly words, generally not connected by any grammatical devices. Secondly, the data consisted also of some phrases with grammatical linkages between the words in such phrases. The sentences were, indeed, very few. The few sentences that were uttered in a complete form were mainly short utterances of the N + V verbal sentences type. The length of the sentences did not generally exceed two or three words. A chief characteristic of the sentences was the excessive nasality, lengthening of the vowels, monotonous delivery and some breathy voice.

The connections between sentences were not marked since all the words in a stretch of utterance were marked by pauses in between them almost in an equal measure.

The congenitally partially hearing subjects had more well-formed complete sentences than the elliptical ones as found in the speech of the profoundly hearing impaired. However, there was nasality, lengthening of vowels and breathiness in voice in most of the subjects. There was a blend of single word utterances, elliptical utterances and sentences of various types. However, the length of the sentences did not exceed five words in a sentence. In other words, although the phrases, and other utterances did indicate a variety of linguistic structures and discourse connectors, the language of the partially hearing continued to be deficient in length. We found that N + N sentence type and N + Adj. + N, N + V, and N + Adv. + V sentence types dominated the utterances. Adjectival and adverbial markers tended to be slurred or dropped. In fact the speech of the partially hearing suffered from a tendency to telescope the morphemes of a long word. This telescoping was generally achieved by slurring, but partly by dropping of affixes, and faltering individual production of affixes with pauses in between affixes.

The above characterization does not hold good for persons who acquired hearing impairment later in life.

In all the cases, there was a tendency to grope for words, a tendency caused perhaps by an inability for self-monitoring and reception of feedback from others.

(ii) Juncture

Juncture plays an important role at the speech level in signifying the structural complexity in language. Our subjects and great difficulty in exploiting and making proper use of this features of speech for comprehension of the structural complexity at the language level. This was

mainly because of the indiscriminate use of pauses that the hearing impaired exhibited between all words in a stretch of utterance. The routine occurrence of pauses that are lengthier than the ones found in the language of the normal hearing did not give room for use of such pauses to distinguish between the underlying grammatical structures as done in the language of the normal hearing.

(iii) Separation of One Sentence from Another

In normal language, separation of one sentence from another in speech is marked by intonation patterns at the speech level. It is also marked by sentential pauses. In some languages, it could be signified by euphonic devices in the form of occurrence of certain vowels/ consonants at the end of a sentence, or even at the beginning of a sentence. It could also be signified by suitable interjections. That an utterance is not a single sentence and that it is a combination of sentences is marked by a change in the intonation at the end of the "sentences" preceding the main sentence. At the segmental level, such a combination could also be accompanied by morphophonemic changes. Certain structural characteristics could also contribute to the separation of one sentence from another - such structural characteristics could be the location of some selected grammatical category at the "end" of a sentence; it could also be certain inflections to the word occurring at the "end" of the sentence; it could be a combination of affixes in a particular order. Occurrence of such particles may also have certain specific phonetic characteristics.

The type of hearing loss appears to be the dominant factor in the hearing impaired's ability to utter sentences separate from one another. In most case, the pauses, both interword and intersentential, are indistinguishable from the general appearance of faltering in the speech of the hearing impaired. As already pointed out, the profoundly hearing impaired tend to have pauses between all words in

a stretch of utterance. Both the congenitally profoundly hearing impaired and the partially hearing impaired do not have appropriate sentence intonations. Relatively speaking, the partially hearing subjects in our investigation had presented several structures that resemble sentence intonation, but, then, the excessive use of pauses and the monotonous presentation of utterances make it difficult to recognize them as proper intonations, making one sentence from another. The language of the normal hearing (Kannada) uses the euphonic device of a word/sentence final *-u* to mark the end of a word/sentence along with the intonation. This euphonic device is not clearly used in the language of the profoundly hearing impaired subjects, whereas several of the partially hearing subjects did use at random this device. There was slurring over individual sounds and syllables, where there was breathiness and nasality over the portions of an utterance, a sentence-like utterance. Thus, the occurrence of slurring and breathiness of voice did not allow much room for the use of the euphonic device in the speech of the hearing impaired. Note that what is most easily exhibited almost as an involuntary release becomes a hard to perform task, thus revealing the value of the particular euphonic device of the language of the normal hearing.

The interjections found in our subjects appeared to have a mechanical function in that the interjections were not related to thought processes, deliberate physiological preparations for speech, or stylistic differences in speech delivery.

The morphophonemic changes are not attested except the occasional *u / v* and *i / y* alternations and the velarisation of the alveolar nasal in word final positions when followed by a word beginning with a velar stop. The few morphophonemic changes that we notice in our hearing impaired subjects were, thus, the rules of external sandhi. It appears to us that the language of the hearing

impaired is marked by the absence of rules of internal sandhi of various types noticed in the normal hearing Kannada language.

(iv) speech Elements of the Discourse

The speech characteristics of the discourse in normal language include the features that we listed under the sub-section **Separation of One Sentence from Another**. It also includes the futures of continuity, appropriate speed of delivery, accommodation of the listener and other paralinguistic features. Features of continuity include appropriate uses of intonations to mark that a sentence is complete or is still in progress, appropriate use of pronouns of reference, cohesion between lexical items chosen and used, and coherence of communication of ideas, etc. The profoundly hearing impaired in our investigation were seen to be marked out by their difficulties with or non-use of sentence intonations, as already pointed out. That a sentence is still in progress is the feeling that a normal hearing person always gets when an utterance is uttered by a hearing impaired persons even in contexts in which the sentences might have been uttered in full form. This is valid even for the congenitally partially hearing impaired children and for those who acquired the impairment later in life. We have already discussed the speed of delivery of speech in the hearing impaired. One of the significant marks of the speech characteristics of the language of the hearing impaired is the absence of relative pronouns in the profoundly hearing impaired subjects of our study. Even in the case of the partially hearing subjects, we find that the subjects engage themselves in strategies that avoid production of sentences that would involve back references through use of pronouns. That is, the utterance are so framed that back references are to be supplied by the listener only. Lexical strategies are exploited for the description of the person referred to through labeling and

using the names, rather than using pronouns of back reference.

3.9. To Conclude

There is more to hearing impairment than hearing loss or inadequacy of hearing. The hearing impairment could affect the cognitive processes in several ways. Reference to this has already been made by us in earlier sections. There are several indicators that the hearing impairment does affect cognitive processes. Our subjects had difficulty with adjectives of colour and quantity - both the profoundly hearing impaired and the partially hearing exhibited these difficulties. The sparse data that we could obtain from the profoundly hearing impaired did not show the process of abstraction adopted by them; however, the partially hearing subjects adopted strategies to indicate possession and belongingness in ways different from the normal hearing. While this is surely an indication that the hearing impaired have their own strategies of lexical voice and word order for communication, we also found that these strategies were not clearly extended as a general pattern, even in the subjects that had more than sparse utterances. We shall see the difficulties with grammatical structures the hearing impaired has in another monograph planned.

An important distinction between the normal hearing and the partially hearing young children was the drastic reduction in the loud egocentric speech in the hearing impaired young children. The relationship between and essentiality of the egocentric and inner speech together for later day thought processes have been generally agreed upon. The hearing impaired young children were seen to have difficulties with the progress of egocentric and inner speech. Kyle, et al. (1978) propose that reading difficulties with language materials the hearing impaired have are to be related to the representational

inadequacy of the inner speech that these children were seen to have. It is seen by investigators (for example, Darbyshire, 1977) that while evolution of play follows Piaget's three-fold development pattern in young hearing impaired children, the play of the hearing impaired children slows down in relation to hearing children as they grow older. Darbyshire also reports that games involving rules were the most difficult for hearing impaired children.

Thinking with restricted language is a good description of the thought processes of the congenitally profoundly hearing impaired and the partial hearing young children. The implications of this restricted language on this thinking are reflected in the lack of adjectives, qualifying adverbs and the lack of elaborate processes of abstraction in the language of the congenitally hearing impaired.

The partially hearing impaired make use of several alternate strategies in their language communication. We already referred to changes in labeling possession and belongings adopted by our subjects. In the absence of elaborate labeling tools in the form of words, most of the prelingually hearing impaired subjects tend to categorize people and objects around them into some broad categories such as good or bad, black or white, long or short, etc. That is, while the basic elements of categorization of people and objects around them is seen in the language behaviour of the prelingually deaf, they are left with only the minimum, and are not able to go beyond for an intricate network of classification and categorization.

There is yet another tendency seen - the prelingually hearing impaired children show a tendency towards easier recognition of accurate nouns. That is, even within a single category of linguistic items they are not in a position to recognize all the sub-components of the particular category.

This latter tendency is matched by the deficient use of the physiological speech production mechanism in the prelingually hearing impaired children. While they produce some sounds of a category, they fail to produce even a full category of sounds such as the aspirated group in Kannada. They are not able to use certain sounds such as the sibilants effectively in our investigation. Among the physiological mechanisms for speech production, the prelingually hearing impaired children are seen to have greater difficulty with the use of language. In other words, while the children are able to use some articulators, they are unable to use other articulators efficiently.

In many areas of language acquisition, it is shown that while there is not much difference between the rate and quality of language acquisition in the early stages (Paskowitz and Bond, 1982-1983) soon the hearing impaired children show difficulties in maintaining the rate and quality of acquisition exhibited by normal hearing children (Oller, et al., 1978). That is, the prelingually hearing impaired acquire whatever language they also do not acquire fully all the essentials of the language of the normal hearing.

One of the problems that prelingually hearing impaired children exhibit is their inability for anticipatory coarticulation which is a very important part of language communication involving more than one person. This is to be also related to the inappropriate balance between the speech production and speech reception skills in the prelingually hearing impaired. Novelli-Olmstead and Ling (1984) found that training in speech production led to highly significant gains both in speech production and in auditory discrimination of speech, whereas training in listening only showed slight gains in speech production and no gains in auditory discrimination. Robb, et al. (1985) find that hearing impaired speakers' speech motor skills vary in relation to auditory perception. They find that for each

level of hearing loss (moderately severe, severe, profound) there are speech-timing coordination deficits commensurate with the level. Experiments have indicated that the normal hearing speakers are aware of the articulatory movements associated with the speech sounds (Ruscello, et al., 1980). However, in the case of the hearing impaired, the results indicate instability in the production of speech sounds, with variability both in physiological and acoustic measurements. That is, there is no consistency noticed in the use of articulators. This has led to the conclusion that, with reference to consonant articulation, the hearing impaired may place their articulators accurately but fail to coordinate the movement of several articulators, showing deficiency in motor movements. In the case of vowel production, the hearing impaired may or may not move their articulators only within a restricted range. Also the hearing impaired are seen to be unable to control suprasegmental features of speech (McGarr and Harris, 1980). The hearing impaired subjects showed more variable tongue shape and position than normal subjects (Tye and others, 1983). Also note that tasks such as sustained vowel and syllable repetitions yield differential respiratory behaviours between the hearing impaired and normal hearing subjects (Itoh, et al., 1982). Incorrect production of intonation contours is seen as common phonatory problem among the hearing impaired (Friedman, 1985). In other words, there are differences between the normal hearing and the prelingually hearing impaired children with respect to the developmental aspects of language, articulatory patterns, suprasegmental patterns, production patterns, control mechanisms and speech intelligibility.

A distinction is generally made between surface phonetic appearances of a form and its underlying phonological representation. For instance, the Tamil form *Maraṅgaḷ* 'tree' includes the underlying phonological form *maram* 'tree'. This latter form undergoes several changes

when the plural suffix *-kal* is added to it. The normal hearing child relates the two forms and masters both underlying phonological representation as well as the surface forms. This is only a small instance. There are areas in grammar in which construction of phrases depends entirely on an understanding or grasp of the nature of the formal characteristics of the underlying form inflections for tense, number, case, gender, among others, are decided by the nature of the formal characteristics of underlying phonological representation. Even ambiguity in the meaning conveyed by a phrase or sentence is at times resolved by taking an unconscious recourse to the characteristics of the underlying phonological representations. Investigators have attempted to identify the nature of understanding of the rules of phonological representations in the language of the hearing impaired. Prelingually, profoundly hearing impaired individuals would not have been exposed to develop the rules of relationship between surface forms and underlying phonological representations. That is, the hearing impaired children would not have been expected to have the same access to phonological information as hearing children do. This should result in difficulties in using phonological structure to relate different morphological forms of words. This feature of the language of the prelingually hearing impaired also contributes to the peculiarity of the language.

Literature clearly indicates that the channels of reinforcement are affected in a vicious cycle in the language learning contexts of the hearing impaired children. The hearing impaired children show difficulties with regard to a proper interrelationship between the three essential dimensions of speech production and output, namely, the acoustic signal, the articulatory shapes generating it and the muscle contractions controlling the movements of articulators. These are the three essential dimensions in any speech production and output (Harris, 1976). The problems

with the inter-relationship with these dimensions on that part of the hearing impaired children lead the caregivers to modify their own linguistic behaviour with the intention of helping the hearing impaired comprehend what the caregivers utter. This has been very well attested in the studies of maternal speech addressed to the hearing impaired children. Complexity of speech features, use of selected utterances and sentence types, repetitions, expansions, utterance acceptability and fluency (Nienhuys, et al., 1984). In several ways, the hearing impaired condition of children comes to regulate the entire communicative acts of the caregiver, and this, in its turn, does not help maintain and widen the channels of reinforcement of oral language. It is not as if the caregivers alone are doing this. Even the peers are known to modify their communicative acts in several ways when they interact with the hearing impaired children. For example, Arnold and Tremblay (1979) report on how hearing children interacted with hearing impaired children and modified their communication skills depending upon the extent of hearing impairment. They found that hearing children interacted more frequently with other hearing children on several behavioural categories. There was a tendency for the hearing impaired children to approach the other hearing impaired children more frequently than they approached the hearing children and yet there was no effort on the hearing impaired children to seek for everything the hearing impaired. That is, while hearing impaired children showed no peer preference, they were least preferred by normal peers. Thus, the problems of hearing impairment go from acoustic and articulatory bases to a much wider social-psychological contexts of the hearing impaired.

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REFERENCES

- ALBRIGHT, P., HIPSKIND, N.M., AND SCHUCKERS, G.H. A Comparison of visibility and Speech Reading Performance on English and Slurvian. *J. Commun. Dis.*, 6(1), 1977, pp.44-52.
- ANGELOCCI, A., KOPP, G. AND HOLBROOK, A. The Vowel Formants of Deaf and Normal Hearing Eleven to Forteen Years Old Boys. *Journal of Speech and Hearing Disorders*, 24, 1964, pp. 156-170.
- ARNOLD, D. AND TREMBLAY, A. Interaction of Deaf and Hearing Pre-School Children. *Journal of Commun. Dis.*, 12, 3, 3, 1979, pp. 245-251.
- ASHOK KUMAR, M. A High Risk Register for Hearing Loss in Children : A Feasibility Study on an Indian Population. Unpublished M.Sc.(Speech And Hearing) Dissertation, All India Institute Of Speech And Hearing, Mysore 1981.
- BATES, E., CAMAIONI, L. AND VOL TERRA, V. The Acquisition Of Performatives Prior To Speech. *Merril-Palmer Quart.*, 21(3), 1975, Pp. 205-226.
- BERGER, K.W. *Speech-Reading Principles And Methods*. National Educational Press, Baltimore, 1972.
- BERRY, M.F. *Language Disorders Of Children : The Bases And Diagnoses*. Appleton, New York, 1969.
- BERRY, M.F. AND EISENSEN, J. *Speech Disorders : Principles And Practices Of Therapy*. Appleton, New York, 1956.
- BINNIE, C.A., MONTGOMERY, A.A. AND JACKSON, P.L. Auditory And Visual Contributions To The Perception Of Consonants. *Journal Of Speech And Hearing Research*, 17, 1974, Pp. 619-630.
- BLACHE, S.E. *The Acquisition Of Distinctive Features*. University Park Press, Baltimore, 1978.

- BLOOMFIELD, L. *Language* Holt, New York, 1933.
- BLOUNT, B. The Prelinguistic Systems And Two Children. *Anthropological Linguistics*, 12, 1979, pp.326-342.
- BOON, D.R. Modification Of The Voices Of Deaf Children. *The Volta Review*, 68, 1978, pp.686-694.
- BOOTHROYD, A. Speech Perception And Sensorineural Hearing Loss. In M. Ross And T.G. Giolas (Eds.), *Auditory Management Of Hearing Impaired Children*. University Park Press, Baltimore, 1978, pp.117-144.
- BOOTHROYD, A. AND DECKER, M. Control Of Voice Pitch By The Deaf. *Audiology*, 11, 1972, pp.343-353.
- BRINICH, P.M. Childhood Deafness And Maternal Control. *Journal of Commun. Dis.*, 13, 1, 1980, pp. 75-88.
- BYMAN, J. Testing Of Auditory And Audio-Visual Speech Perception Related To Everyday Communication. *Scand. Audio., Suppl.*, 4, 1974, pp.58-66.
- CALVERT, D. Deaf Voice Quality : A Preliminary Investigation *Volta Review*, 64, 1962, pp.402-403.
- CARR, J. An Investigation Of The Spontaneous Speech Sounds Of Five Year Old Deaf-Born Children. *Journal Of Speech And Hearing Disorders*, 18, 1953, pp.22-23.
- CARROLL, J.B. Language Development In Children. In S. Saporta (Ed.), *Psycho-Linguistics: A Book Of Readings*. Holt, New York, 1961, pp.331-345.
- CHAMPIE, J. Language Development In One Pre-School Deaf Child. *American Annals Of The Deaf*, 126, 1, 1981, pp.43-48.
- CHERRY, C. *On Human Communication*, M.I.T. And Wiley, New York, 1957.
- CHESKIN, A. The Verbal Environment Provided By Hearing Mothers For Their Young Deaf Children. *Journal Of Commun. Dis.*, 14, 6, 1981, pp. 484-496.

- CHESKIN, A. The Use Of Language By Hearing Mothers Of Deaf Children. *Journal Of Commum. Dis.*, 15, 2, 1982, pp. 145-153.
- CLARK, E.V. From Gesture To Word: On The Natural History Of Deixis In Language Acquisition. In J.S. Bruner And A. Garton (Eds.), *Human Growth And Development*, Oxford University Press, London, 1978.
- CLOUSER, R.A. Relative Phoneme Visibility And Lipreading Performance. *The Volta Review*, 79, 1, 1977, pp.27-34.
- CRUTTENDEN, A. A Phonetic Study Of Babbling. *British Journal Of Disorders Of Communication*, 5(2), 1970, pp.110-118.
- CRUTTENDEN, A. *Language In Infancy And Childhood*. Manchester University Press, Manchester, 1979.
- DARBYSHIRE, J.O. Play Patterns In Young Children With Impaired Hearing. *The Volta Review*, 79, 1, 1977, pp.19-26.
- De VILLIERS, J. AND De VILLIERS, D. *Language Acquisition*. Harvad University Press, Cambridge, Mass., 1978.
- DOBIE, R.A. AND BERLIN, C.I. Influence Of Otitis Media On Hearing And Development. *The Annals Of Otology, Rhinology And Laryngology*, 88, 5(2), 1979, pp.48-53.
- DORE, J., FRANKLIN, M., MILLER, R. AND RAMER, A. Transitional Phenomena In Early Language Acquisition. *Journal Of Child Language*, 3, 1976, pp. 13-28.
- EISENBERG, R.B. *Auditory Competence In Early Life : The Roots Of Communicative Behaviour*. University Partk Press, Baltimore, 1976.
- EISENSON, J. (Ed.). *Stuttering : A Symposium*. Harper, New York, 1958.
- EISENSON, J. *Aphasia In Children*. Harper, New York, 1972.

- EISENSON, J., AUER, J. AND IRWIN, J. **The Psychology Of Communication.** Appleton-Century-Crofts, 1963.
- ELLIOTT, L.L. Effects Of Noise On Perception Of Speech By Children And Certain Handicapped Individuals. **Sound And Vibration**, 16, 12, 1982, pp.10-14.
- ENGELBERG, M. Correction Of Palsetoo Voice In A Deaf Adult. **Journal Of Speech And Hearing Disorders**, 27, 1962, pp.162-164.
- FLETCHER, S.G. AND DALY, D.A. Nasalance In Utterances Of Hearing Impaired Speakers. **Journal Of Commun. Dis.**, 9, 1976, pp.63-73.
- FRIEDMAN, M. Remediation Of Intonation Contours Of Hearing Impaired Students. **Journal Of Commun. Dis.**, 18, 4, 1985, pp.259-272.
- FRY, D.B. The Development Of The Phonological System In The Normal And Deaf Child. In F. Smith And G.A. Miller (Eds.), **The Genesis Of Language**, M.I.T. Press, Cambridge, Mass., pp.187-206.
- FRY, D.B. Acoustic Cues In The Speech Of The Hearing And The Deaf. **Proc. Roy. Soc. Med.**, 66, 1973, pp.959-969.
- GEFFNER, D. Feature Characteristics Of Spontaneous Speech Production In Young Deaf Children. **Journal Of Commun. Dis.**, 13, 1980, pp. 443-454.
- GILBERT, J.H.V. Babbling And The Deaf Child : A Commentary On Lenneberg, Et Al. (1965) And Lenneberg (1967). **Journal Of Child Language**, 9,2, 1982, pp. 511-515.
- GILBERT, H.R. AND CAMBELL, M.I. Speaking Fundamental Frequency In Three Groups Of Hearing Impaired Individuals. **Journal Of Commun. Dis.**, 13(3), 1980, pp.511-515.
- GOLD, T. Speech Production In Hearing Impaired Children. **Journal Of Commun. Dis.**, 13(6), 1980, pp.397-418.

- GOLDSTEIN, M.H. AND STARK, R.E. Modification Of Vocalizations Of Pre-School Deaf Children By Vibrotactile And Visual Displays. *Journal Of The Acoustical Society Of America*, 59, 1976, pp.1477-1481.
- GRAY, T.F. Ability Of Hearing Impaired Listeners To Understand Connected Discourse. *J. Amer. Audiol. Soc.*, 3(3), 1977, pp.159-166.
- GREENBERG, J.H. (Ed.). *Universals Of Language*, The M.I.T. Press, Cambridge, Mass, 1966 (Second Edition).
- HARRIS, K.S. Physiological Aspects Of Speech Production. *Haskins Laboratories Status Report On Speech Research*, 48, 1976, pp.21-42.
- HUDGINS, C.V. A Comparative Study Of The Speech Coordination's Of Deaf And Normal Hearing Subjects. *Journal Of Genetic Psychology*, 44, 1934, pp.3-48.
- HUDGINS, C.V. AND NUMBERS, F.C. An Investigation Of The Intelligibility Of The Speech Of The Deaf. *Genetic Psychology Monographs*, 25, 1942, pp.289-392.
- HUNTINGTON, D., HARRIS, K.S. AND SHOLES, G. An Electromyographic Study Of Consonant Articulations In Hearing Impaired And Normal Speakers. *Journal Of Speech And Hearing Research*, 11, 1968, pp. 147-158.
- HURLOCK, E.B. *Child Growth And Development*. Mc Graw-Hill Book Company, Inc., New York, 1956.
- INDIRA. Analysis Of Infant Cries. Unpublished M.Sc.(Speech And Hearing) Dissertation, All India Institute Of Speech And Hearing, Mysore, 1981.
- IRWIN, O.C. (a) Infant Speech : Consonantal Sounds According To Place Of Articulation. *Journal Of Speech Disorders*, 12, 1947, pp. 397-401.
- IRWIN, O.C. (b) Infant Speech : Consonant Sounds According To Manner Of Articulation. *Journal Of Speech Disorders*, 12, 1947, pp.402-404.

- IRWIN, O.C. Infant Speech : Development Of Vowel Sounds. *Journal Of Speech And Hearing Disorders*, 13, 1948, pp. 31-34.
- IRWIN, O.C. AND CHEN, H.P. Infant Speech : Vowel And Consonant Frequency. *Journal Of Speech Disorders*, 11, 1946, pp.124-125.
- ITOH, M., SASANUMA, S., TATSUMI, I.F., MURAKAMI, S., FUKUSAKO, Y. AND SUZUKI, T. Voice Onset Time Characteristics In Apraxia Of Speech. *Brain And Language*, 17, 1982, pp. 193-210.
- JAKOBSON, R. *Child Language Aphasia And Phonological Universals*. Mouton, The Hague, 1968.
- JAKOBSON, R. (1959). Why "Mama" And "Papa"? In *Selected Writings*, Vol.1, Mouton, The Hague, 1971.
- JOHN, J.E.J. AND HOWARTH, J.N. The Effects Of Time Distortions On The Intelligibility Of Deaf Children's Speech. *Language And Speech*, 8, 1965, pp. 127-134.
- KENWORTHY, O.T. Caregiver-Child Interaction And Language Acquisition Of Hearing Impaired Children. *Topics In Language Disorders*, 6,3, 1986, pp.1-11.
- KYLE, J.G. The Study Of Auditory Deprivation From Birth. *British Journal Of Audiology*, 12, 1978, pp.37-39.
- KYLE, J.G., CONRAD, R., Mc KENZIE, M.G., MORRIS, A.J.M. AND WEISKRANTZ, B.C. Language Abilities In Deaf School Leavers. *The Teachers Of The Deaf*, 2, 1978.
- LATHE. Speech-Reading Discrimination Of Homophenes. Unpublished M.Sc.(Speech And Hearing) Dissertation, All India Institute Of Speech And Hearing, Mysore, 1978.
- LEDERBERG, A.R. Interaction Between Deaf Pre-Schoolers And Unfamiliar Hearing Adults. *Child Development*, 55, 2, 1984, pp. 598-606.
- LEHISTE, I , The M.I.T. Press, Cambridge, Mass., 1970.

- LENNEBERG, E.H., REBELSKY, F.G. AND NICHOLS, I.A.
The Vocalizations Of Infant Born To Deaf And To Hearing Parents. *Vita Hum.*, 8(1), 1965, pp.23-37.
- LEVITT, H. Speech Processing Aids For The Deaf : An Overview. In *Conference Record, 1972, IEEE Conference On Speech Communication And Processing*. IEEE, New York, 1972, pp.230-234.
- LEVITT, H., SMITH, C.R. AND STROMBERG, H. Acoustical, Articulatory And Perceptual Characteristics Of The Speech Of Deaf Children. In G. Fant (Ed.), *Proceedings Of The Speech Communication Seminar*, Wiley, New York, 1976, pp.129-139.
- LEVITT, H., STROMBERG, H., SMITH, C. AND GOLD, T. The Structure Of Segmental Errors In The Speech Of Deaf Children. *Journal Of Commun. Dis.*, 13, 1980, pp.419-442.
- LIBERMAN, A.M., DELATTRE, P.C., COOPER, F.S. AND GERSTMAN, L.J. The Role Of Consonant-Vowel Transitions In The Perception Of The Stop And Nasal Consonants. *Psychological Monographs*, 68, 1954.
- LIEBERTH, A., SUBTELNY, J.D. The Effect Of Speech Training On Auditory Phoneme Identification. *Volta Review*, 80(6), 1978, pp.410-417.
- LING, D. The Functions Of A Modern Oral School For The Deaf. *Voice*, 6, 1963, pp.3-8.
- LING, D. *Speech And The Hearing Impaired Child : Theory And Practice*. Alexander Graham Bell Association For The Deaf, 1976.
- LING, D. Auditory Coding And Recoding : An Analysis Of Auditory Training Procedures For Hearing Impaired Children. In M. Ross And T.G. Giolas (Eds.), *Auditory Management Of Hearing Impaired Children*, University Park Press, Baltimore, 1978, pp.181-218.
- LYON, M. The Verbal Interaction Of Mothers And Their Pre-School Hearing Impaired Children : A Preliminary

- Investigation. *The Teacher Of The Deaf*, 9/5, 1985, pp.119-129.
- MACCOBY, E.E. Some Speculations Concerning The Lag Between Perceiving And Performing. *Child Development*, 36, 1965, pp.367-377.
- MANNING, W.H., WITTSTRUCK, M.I., LLOYD, R.R. AND CAMPBELL, T.F. Automatization Of Correct Production At Two Levels Of Articulatory Acquisition. *Journal Of Speech And Hearing Disorders*, 42, 1977, pp.358-363.
- MARKIDES, A. The Speech Of Deaf And Partially Hearing Children With Special Reference To Factors Affecting Intelligibility. *British Journal Of Disorders Of Communication*, 5, 1970, pp.126-140.
- MAZOR, M., SIMON, H., SCHIENBERG, J. AND LEVITT, H. Moderate Frequency Compression For Moderately Hearing Impaired. *J. Acoust. Soc. Amer.*, 62(5), 1977, pp.1273-1278.
- MAVILYA, M. Spontaneous Vocalization And Babbling In Hearing Impaired Infants. In G. Fant (Ed.), *International Symposium On Speech Communication Abilities And Profound Deafness*. Alexander Graham Bell Association For The Deaf, 1972, pp.163-171.
- McGARR, N.S. AND HARRIES, K.S. Articulatory Control In A Deaf Speaker. *Haskins Laboratories Status Report On Speech Research*, Sr-63/64, 1980, pp.309-332.
- MENYUK, P. *The Development Of Speech*, Bobbs-Merill, New York, 1972.
- MENYUK, P. Design Factors In The Assessment Of Language Development In Children Otitis Media. *The Annals Of Otolaryngology, Rhinology And Laryngology*, 88, 5(2), 1979, pp.78-87.
- MILLER, J.G. AND YODER, D.E. An Ontogenetic Language Teaching Strategy For Retarded Children. In R.L.

- Schiefelbrush And L.L. Lloyd (Eds.), **Language Perspectives : Acquisition, Retardation And Intervention**, University Park Press, 1974, pp.050-528.
- MOGFORD, K., GREGORY, S. AND KEAY, S. Picture Book Reading With Mother : A Comparison Between Hearing Impaired And Hearing Children At 18 And 20 Months. **The Teacher Of The Deaf**, 3, 2, 1979, pp.43-45.
- MONSEN, R.B. Durational Aspects Of Vowel Production In The Speech Of Deaf Children. **Journal Of Speech And Hearing Research**, 17, 1974, pp.386-398.
- MONSEN, R.B. (a) Normal And Reduced Phonological Space : The Production Of English Vowels By Deaf Adolescents. **Journal Of Phonetics**, 4, 1976, pp.189-198.
- MONSEN, R.B. (b) The Production Of English Stop Consonants In The Speech Of Deaf Children. **Journal Of Phonetics**, 4, pp.29-42.
- MONSEN, R.B. (c) Second Formant Transitions Of Selected Consonant-Vowel Combinations In The Speech Of Deaf And Normal Hearing Children. **Journal Of Speech And Hearing Research**, 19, 1976, pp.279-289.
- MONSEN, R.B. Toward Measuring How Well Hearing Impaired Children Speak. **Journal Of Speech And Hearing Research**, 21, 1978, pp.197-219.
- MORLEY, M.E. **The Development And Disorders Of Speech In Childhood**. Livingstone, London, 1972.
- MOSKOWITZ, A. The Two-Year Old Stage In English Phonology. **Language**, 46, 1970, pp.426-441.
- MOWRER, O.H. **Learning Theory And Personality Dynamics : Selected Papers**. Ronald Press, New York, 1950.
- MOWRER, O.H. **Learning Theory And The Symbolic Processes**. Wiley, New York, 1960.

- MUIR, D. AND FIELD, J. Newborn Infants Orient To Sounds. *Child Development*, 50, 2, 1979, pp.431-436.
- NAKAZIMA, S. A Comparative Study Of The Speech Developments Of Japanese And American English In Childhood. *Studia Phonologica*, 2, 1962, pp.27-39.
- NIKCERSON, R.S. Characteristics Of The Speech Of Deaf Persons. *Volta Review*, 77, 1975, pp.342-362.
- NICKERSON, R.S., STEVENS, K.N., BOOTHROYD, A. AND ROLLINS, A. Some Observations On Timing In The Speech Of Deaf And Hearing Speakers. **Report No.2905**, Bolt, Beranek And Newman, Cambridge, Mass., 1974.
- NIENHUYS, T.G., CROSS, T.G. AND HORSBOROUGH, K.M. Child Variables Influencing Maternal Speech Style : Deaf And Hearing Children. *Journal Of Communication Disorders*, 17, 3, 1984, pp.189-207.
- NIENHUYS, T.G. AND TIKOTIN, J.A. Pre-Speech Communication In Hearing And Hearing Impaired Children. *The Teacher Of The Deaf*, 7, 6, 1983, pp.182-194.
- MOVELLI-OLMSTEAD, T. AND LING, D. Speech Production And Speech Discrimination By Hearing Impaired Children. *The Volta Review*, 86, 2, 1984, pp.72-80.
- OLLER, D.K. AND KELLY, C.A. Phonological Substitutions Of A Hard Of Hearing Child. *Journal Of Speech And Hearing Disorders*, 39, 1974, pp.65-74.
- OLLER, D.K., WIEMAN, L.A., DOYLE, W.J. AND ROSS, C. Infant Babbling And Speech. *Journal Of Child Language*, 3, 1976, pp.1-11.
- OLLER, D.K., JENSEN, H. AND LAFAYETTE, R. The Relatedness Of Phonological Processes Of A Hearing Impaired Child. *Journal Of Commun. Dis.*, 11, 1978, pp.97-106.

- PASKOWITZ, P. AND BOND, Z.S. Phonological Structure Of The Speech Of Three Hearing Impaired Children. *Ohio Journal Of Speech And Hearing*, 16, 1982-1983, pp.1-10.
- PHILLIPS, N., REMILLARD, W., BASS, S. AND PRONOVOST, W. Teaching Of Intonation To The Deaf By Visual Pattern Matching. *American Annals Of The Deaf*, 113, 1968, pp.239-246.
- PICKETT, J.M. Tactual Communication Of Speech Sounds To The Deaf : Comparison With Lip-reading. *Journal Of Speech And Hearing Disorders*, 28, 1963, pp.315-330.
- PICKETT, J.M. AND COSTAM, A. A Visual Speech Trainer With Simplified Indication To Vowel Spectrum. *American Annals Of The Deaf*, 113, 1968, pp.253-258.
- PLANS, G. AND SPENS, K-E. An Experienced User Of Tactile Information As A Supplement To Lip-reading : An Evaluating Study. *Speech Transmission Laboratory Quarterly Progress And Status Report*, 1, 1986, pp.87-110.
- POPELKA, G.R. AND BERGER, K.W. Gestures And Visual Speech Reception. *American Annals Of The Deaf*, 116(4), 1971, pp.434-436.
- RAJAPUROHIT, B.B. *Acoustic Characteristics Of Kannada*. Central Institute Of Indian Languages, Mysore, 1982.
- REILLY, A.P. *Syllabic Nucleus Duration In The Speech Of Deaf Adults*. Unpublished Doctoral Dissertation, City University Of New York, 1979.
- RICHARDSON, K., PECKHAM, C.S. AND GOLDSTEIN, H. Hearing Levels Of Children Tested At 11 Years : A National Study. *British Journal Of Audiology*, 10, 4, 1976, pp.117-121.
- ROBB, M.P., HUGHES, M.C. AND FRESE, D.J. Oral Diadochokinesis In Hearing Impaired Adolescents.

- Journal Of Communication Disorders**, 18, 2, 1985, pp.79-89.
- ROTHMAN, H.A. Spectrographic Investigation Of Consonant-Vowel Transitions In The Speech Of Deaf Adults. **Journal Of Phonetics**, 4, 1976, pp.129-136.
- ROTHMAN, H. AN Electromyographic Investigation Of Articulation And Phonation Patterns In The Speech Of Deaf Adults. **Journal Of Phonetics**, 5, 1977, pp.369-376.
- RUSCELLO, D.M., SHOLTIS, D.M. AND MOREAU, V.K. Adult's Awareness Of Certain Articulatory Gestures. **Perceptual And Motor Skills**, 50, 3(2), 1980, pp.1156-1158.
- SALUS, P.H. AND SALUS, M.W. Rule Ordering In Child Phonology. Paper Presented At The Stanford Child Language Forum, Palo Alto, California, 1973.
- SCHIENBERG, J.S. Analysis Of Speech-Reading Cues Using An Interleaved Technique. **Journal Of Commun. Dis.**, 13(6), 1980, pp.489-492.
- SEAYER, E.J., ANDREWS, J.R. AND GRANATA, J.J. A Radiographic Investigation Of Velar Positioning In Hearing Impaired Young Adults. **Journal Commun. Dis.**, 13(3), 1980, pp.239-247.
- SEDLACKOVA, E., LASTOVKA, M. AND SRAM, F. Contribution To Knowledge Of Soft Palate Innervation. **Folia Phoniat**, 25(6), 1973, pp.434-441.
- SHAFFER, D. AND LYNCH, J. Emergent Language Of Six Pre-Lingually Deaf Children. **The Teacher Of The Deaf**, 5, 4, 1981, pp.94-111.
- SHAH, C.P., CHANDLER, D. AND DALE, R. Delay In Referral Of Children With Impaired Hearing. **The Volta Review**, 80, 4, 1978, pp.206-215.

- SHERMAN, D. THE Influence Of Vowels On Recognition Of Adjacent Consonants. **Journal Of Speech And Hearing Disorders**, 17, 1952, pp.198-212.
- SIRVIO, P. AND MICHELSSON, K. Sound Spectrographic Cry Analysis Of Normal And Abnormal Newborn Infants. A Review And A Recommendation For Standardization Of The Cry Characteristics. **Folia Phoniatic.**, 28, 1976, pp.161-173.
- SMITH, C.R. Residual Hearing And Speech Production In Deaf Children. **Journal Of Speech And Hearing Research**, 18, 1975, pp.795-811.
- SMITH, C.R. Interjected Sounds In Deaf Children's Speech. **Journal Of Commun. Dis.**, 8, 1975, p.123-128.
- STARK, R.E. Speech Of The Hearing Impaired Child. In L.J. Bradford And W.G. Hardy (Eds.), **Hearing And Hearing Impairment**, Grune And Stratton, 1979, pp.229-248.
- STARK, R.E. AND LEVITT, H. Prosodic Feature Reception And Production In Deaf Children. **Journal Of The Acoustical Society Of America**, 55, 1974.
- STARK, R.E., ROSE, S. AND McLAGAN, M. Features Of Infant Sounds : The First Eight Weeks Of Life. **Journal Of Child Language**, 2, 1975, pp.205-221.
- STERN, D.N., JAFFA, J., BEEBE, B. AND BENNETT, S.L. Vocalizing In Unison And In Alternation : Two Modes Of Communication Within The Mother-Infant Dyad. **Annals Of The New York Academy Of Science : Developmental, Psycholinguistic And Communication Disorders**, 263, 1975, pp.89-100.
- STEVENS, K.N., NICKERSON, R.S., BOOTHROYD, A. AND ROLLINS, A. Assessment Of Nasalization In The Speech Of Deaf Children. **Journal Of Speech And Hearing Research**, 19, 1976, pp.393-416.
- STONE, E.B. and DEYTON, J.W. **Corrective Therapy For The Handicapped Child**. Prentice-Hall, New York, 1951.

- SUSMAN, H. AND HERNANDEZ, M. A Spectrographic Analysis Of The Suprasegmental Aspects Of The Speech Of Hearing Impaired Adolescents. **Audiology And Hearing Education**, 5, 1979, pp.12-16.
- SUZUKI, T. Use Of Heart Rate Response For Assessment Of Hearing In Infants. **The Annals Of Otology, Rhinology And Laryngology**, 87, 2(1) 1978, pp.243-247.
- THIRUMALAI, M.S. **Silent Talk : Nonverbal Communication**. Central Institute Of Indian Language, Mysore, 1987.
- TWADDELL, W.F. Phonemes And Allophones In Speech Analysis. **Journal Of The Acoustical Society Of America**, 24, 1952, pp.607-611.
- TYE, N., ZIMMERMANN, G.N. KELSO, J. AND SCOTT. Compensatory Articulation In Hearing Impaired Speakers : A Cinefluorographic Study. **Journal Of Phonetics**, 11, 2, 1983, pp.101-115.
- VAN RIVER, C. **The Nature Of Stuttering**. Prentice-Hall, Englewood-Cliffs, N.J., 1973.
- VAN RIVER, C. **Speech Correction : Principles And Methods**. Prentice-Hall, New York, 1978.
- WALDEN, B.E., PROSEK, R.A. AND WORTHINGTON, D.W. Predicting Audio-Visual Consonant Recognition Performance Of Hearing Impaired Adults. **Journal Of Speech And Hearing Research**, 17(2), 1974, pp.270-278.
- WEDELL-MONNIG, J. AND LUMLEY, J.M. Child Deafness And Mother-Child Interaction. **Child Development**, 51, 3, 1980, pp.766-784.
- WEISBERG, P. Social And Non-Social Conditioning Of Infant Vocalizations. **Child Development**, 34, 1963, pp.377-388.

- WERNER, H. AND KAPLAN, E. **The Acquisition Of Word Meanings : A Developmental Study.** Soc. Res. Child Develop. Monog., 15, 84, 1952.
- WEST, J. AND WABER, J. A Phonological Analysis Of The Spontaneous Language Of A Four-Year Old, Hard Of Hearing Child. **Journal Of Speech And Hearing Disorders**, 38, 1973, pp.25-35.
- WHETNALL AND FRY, D.B. **The Deaf Child.** Charles C. Thomas, Springfield, Ill., 1964.
- WHITEHEAD, R.L. AND BAREFOOT, S. Some Aerodynamic Characteristics Of Plosive Consonants Produced By Hearing Impaired Speakers. **American Annals Of The Deaf**, 125(3), 1980, pp.366-373.
- WHITEHEAD, R.L. AND JONES, K.O. The Effect Of Vowel Environment On Duration Of Consonants Produced By Normal Hearing, Hearing Impaired And Deaf Adult Speakers. **Journal Of Phonetics**, 6, 1978, pp.77-81.
- WINTZ, H. **Articulatory Acquisition And Behaviour.** Appleton, New York, 1969.
- WIRZ, S.L., SUBTELNY, J.D. AND WHITEHEAD, R.L. Perceptual And Spectrographic Study Of Tense Voice In Normal Hearing And Deaf Subjects. **Folia Phoniatic**, 33, 1981, pp.23-36.
- WOODWARD, M.F. AND BARBER, C.G. Phoneme Perception In Lip-Reading. **Journal Of Speech And Hearing Research**, 3, 1960, pp.212-222.
- ZINKUS, P.W. AND GOTTBEG, M.I. Chronic Otitis Media And Auditory Processing Deficits : A Preventable Learning Disability. **Ohio Journal Of Speech And Hearing**, 13, 2, 1978, p.86-92.

APPENDIX - I

CENTRAL INSTITUTE OF INDIAN LANGUAGES MYSORE 570 006.

A TOOL FOR LANGUAGE EVALUATION OF THE HEARING IMPAIRED

Client Name:

No.:

Age:

Sex:

Date:

Religion:

Place of Birth:

Present address:

Mother tongue:

Other languages to which he/she is exposed to _____

Education:

Informant:

Occupation:

Interviewer:

1. History of the problem:

1.1. Age of identification of hearing loss _____
Congenital / acquired Other physical problems _____

1.2. Identified by _____

1.3. Other relevant history with regard to hearing impairment _____

1.4.1 Did not babble

1.4.2 Babbled for a short period and stopped using oral production

1.4.3 Babbled and continued to use speech but delayed

1.4.4 Used to use good speech but now defective

1.4.5 Others _____

2. Audiological evaluation:

2.1. Diagnosis _____ Date _____
Type/Degree Pattern of hearing loss _____
Progressive/Non-progressive _____

2.2. Latest audiogram taken on _____
Audiogram - affixed/not affixed

R L

2.3. SRT/SDT _____
SDS _____

2.4. Others _____

2.5. Recommendations _____

2.6. Hearing aid history

2.6.1. Recommended _____ on _____
Started to use since _____

2.6.2. The aid is used

1) Constantly _____ since _____

2) Not constantly _____

Reasons _____

- 2.6.3. Aid was/ not changed:
If 'YES', reasons _____
- 2.6.4. Any period of time when the aid was not used continuously for a long period. YES/NO
If 'YES' reasons _____
Effects on speech _____
- 2.6.5. Others _____
- 3. Therapeutic history:**
- 3.1. Attends/ Attended therapy _____
If 'YES', from _____ to _____
Continuously /Not continuously

Number of sessions / week _____
If stopped attending the therapy, reasons _____

_____ Attends additional therapeutic session

- 3.2. Who works the most with the child (at home)

How do they work at home ? _____

- 3.3. What materials are used in Aural/visual/tactual variables in therapy? (With reference to the case files) _____

3.4. Therapist's comments _____

3.5. Others _____

4. Home background:

Normal / Not Normal Occupation
(details)

4.1. Mother _____

Father _____

Siblings 1) _____

2) _____

3) _____

4) _____

Family history of medical problems _____

4.2. Other members at home _____

4.3. Others _____

5. Educational history:

5.1. Attends normal/deaf school _____

5.2. Name of the School _____

Age of the admission to the school _____

Medium of instruction _____

Highest class/standard completed _____

Performance at school : Good/Average/Below
Average, has specific difficulty with the following
subjects _____

Second language _____
 Performance _____ Reading
 performance _____ Writing
 performance _____ Attends
 additional tutoring classes _____

5.3. Others _____

6. Psychological history :

6.1. Intelligence _____ tested On _____

6.2. Behaviour/inter-personal relationship _____

6.3. Others _____

7. Language :

7.1. Primary mode of communication

		Only Oral	Oral/visual (LR/Gestures)	Visual
1) At home :	(a) Parents	_____	_____	_____
	(b) Siblings	_____	_____	_____
2) At school		_____	_____	_____
3) Other places:	(a)	_____	_____	_____
	(b)	_____	_____	_____

Parents demand oral from of communication: sometimes/
 Often/Not at all

7.2. Other aspects _____

8. Occupational history:

9. Other aspects, if any:

10. Discrimination test:**10.1. Individual sounds:**

If the subject can read, word with graphemic representation of the phoneme pairs is placed in front of the subject and the subject is requested to point to the phoneme presented, 'same or different', or imitation responses are obtained for each phoneme pair. Responses are recorded as $\sqrt{}$, X, —, with comments if necessary.

(Note that all the Kannada material were presented only in Kannada script and that, for Kannada words, no gloss was provided in the test).

Response	Comments
1) va - a	
2) ra - sa	
3) bi - e	
4) ša - sa	
5) la - da	
6) pa - a	
7) pha - ša	
8) ra - na	
9) ĵa - ra	
10) e - i	

Response	Comments
11) sa - ʃa	
12) na - ɲa	
13) ʃ - pha	
14) ʃa - ga	
15) na - sa	
16) ya - ja	
17) ya - va	
18) ja - a	
19) ra - la / ra - ɭa	
20) a - ka / a - ga	
21) ʃa - ɭa / sa - la	
22) na - ma	
23) ka - pa / ga - ba	
24) ɭa - la	
25) ta - da	
26) ʃa - ʃa	
27) pha - sa	
28) o - u	
29) dha - da	
30) ja - ʃa	
31) o - a	
32) ɬa - ka / ɖa - ga	
33) ra - a	
34) ta - pa / da - ba	

Response	Comments
35) e - u	
36) pa - ʈa / ba - ɖa	
37) ma - a	
38) ta - ʈa / da - ɖa	
39) ga - ka	
40) sa - ca / ʃa - ʃa	
41) i - a	
42) ʃa - ca	
43) ma - ɳa	
44) ba - ma	
45) ʈa - ɖa	
46) a: - a	
47) ta - ka / da - ga	
48) i - u	
49) ma - va	
50) e - a	
51) u - a	
52) sa - ta	
53) la - na	
54) pa - ba	
55) da -ra / da - ra	
56) ba - a	
57) i - o	
58) a - la	

Response	Comments
59) ga - gla	
60) bba - ba	
61) gga - ga	
62) bi - bli	
63) bla - bba	
64) bba - mba	
65) bha - bba	
66) mba - mra	
67) bi - mba	

10.2 Discrimination (words):

Pictures or graphemic representation of the word pairs (if he can read) is placed in front of the subject. The tester asks the child to point to the picture/grapheme corresponding to the word pair one at a time. The responses are recorded as in 1.1.

Response	Comments
1) Jade - vaḍe 'plait' - 'vaḍa'	
2) ili - ole 'rat' - 'owen'	
3) kaṭṭi - kaḍḍi 'having tied' - 'stick'	
4) katti - katri 'sword' - 'scissors'	

	Response	Comments
5)	ka:su - ka:ru 'coin' - 'car'	
6)	ka:te - katte 'story' - 'donkey'	
7)	ka:ru - a:ru 'car' - 'six'	
8)	ili - ili 'rat' - 'descend'	
9)	ha:su - ha:vu 'to spread' - 'snake'	
10)	ha:vu - ha:lu 'snake' - 'milk'	
11)	kaccu - karu / bi:ja - bi:ru 'to bite' - 'calf' / 'seed' - 'almirah'	
12)	čhatri - čaṭni / handi - haḷadi 'umbrella' - 'chaṭni' / 'pig' - 'yellow'	
13)	ili - idli 'rat' - 'idli'	
14)	naḍe - vaḍe 'to walk' - 'vada'	
15)	ka:su - ka:lu 'coin' - 'leg'	
16)	kattu - kaṭṭu 'neck' - 'to bind'	

	Response	Comments
17)	ha:ru - ha:vu 'to jump' - 'snake'	
18)	u:ta - a:ta / ha:vu - ha:vu 'meal' - 'game' / 'flower' - 'snake'	
19)	kaṭṭu - kappu 'to bind' - 'black'	
20)	baḷe - maḷe / appa - amma 'bangle' - 'rain' / 'father' - 'mother'	
21)	katte - katti / ele - ili 'donkey' - 'sword' / 'leaf' - 'rat'	
22)	magga - manga 'loom' - 'monkey'	
23)	sa:lu - ša:lu 'line' - 'shawl'	
24)	ka:du - ka:ru / a:du - a:ru 'forest' - 'car' / 'goat' - 'six'	
25)	ba:yi - ba:vi 'mouth' - 'well'	
26)	amma - aṇṇa 'mother' - 'elder brother'	
27)	ka:ru - karu 'car' - 'calf'	
28)	anna - aṇṇa 'rice' - 'grand-father'	

	Response	Comments
29)	kappe - katte / kappu - kattu 'frog' - 'donkey' / 'black' - 'neck'	
30)	da:ra - ta:ra 'thread' - 'name of a person'	
31)	taṭṭe - kaṭṭe / 'plate' - 'pavement' / kaṭṭu - taṭṭu 'to bind' - 'to knock'	
32)	hudugi - huḍuga 'girl' - 'boy'	
33)	kai - ṭai 'hand' - 'neck tie'	
34)	ka:ru - sa:ru 'car' - 'curry'	
35)	anna - amma 'rice' - 'mother'	
36)	katti - kattu / halli - hallu 'sword' - 'neck' / 'lizard' - 'tooth'	
37)	kaṭṭi - paṭṭi / 'having tied' - 'list' kappu - kakky 'black' - 'to vomit'	
38)	mara - sara 'tree' - 'necklace'	
39)	ba:ču - ji:pu 'to suck' - 'jeep'	

	Response	Comments
40)	či:pu - ji:pu 'to suck' - 'jeep'	
41)	ka:ru - ya:ru 'car' 'who'	
42)	u:du - o:du / u:ta - o:ta 'to blow' - 'to read' / 'meal' - 'run'	
43)	mane - małe / maņe - małe 'house' - 'rain' / 'wooden seat' - 'rain'	
44)	ka:du - ka:lu / ka:du - ka:lu 'forest' - 'leg' / 'forest' - 'grain'	
45)	ka:ru - ka:lu / ka:ru - ka:lu 'car' - 'leg' / 'car' - 'grain'	
46)	aņņa - anna 'elder brother' - 'rice'	
47)	alli - elli / karu - kere 'there' - 'where' / 'calf' - 'tank'	
48)	dana - dhana / gaņte - ghaņte 'cattle' - 'money' / 'hour' - 'bell'	
49)	bennu - pennu 'back' - 'pen'	
50)	ro:du - no:du 'road' - 'to see'	
51)	ja:di - ga:di / bi:ja - bi:ga 'jar' - 'cart' / 'seed' - 'lock'	

	Response	Comments
52)	kappu - kappe 'black' - 'frog'	
53)	se:bu - ĵe:bu 'apple' - 'pocket'	
54)	a:ta - o:ta / male - moĵe 'game' - 'run' / 'rain' - 'nail'	
55)	koĵu - gu:ĵu 'to give' - 'nest'	
56)	ele - ole 'leaf' - 'oven'	
57)	manga - maga 'monkey' - 'son'	

11. Imitation:

11.1. Individual sounds

Vowels. Items are presented in the following modes: Audition (A) only, Audition and Vision (AV), Audition, Vision and Taction (AVT), and Graphemic (G), if the subject can read. If the subject fails to give consistent responses to 5 to 10 items through A, then presentation of items is done through the next mode of presentation. Only those items incorrectly produced in the first mode should be tested in the second mode. If the subject fails in the second, third mode is also used for presentation.

The test is tape-recorded. Any visual/tactile imitation correctly made, if noted, is recorded, even if the phoneme production is wrong.

	A	AV	AVT	G
--	---	----	-----	---

Vowels:

1) i:

2) u

3) e:

4) æ

5) e

6) u:

7) i

8) a:

9) o

10) a

11) o:

Diphthongs:

1) ai

2) au

Consonants:

1) ri

2) ni

3) ki

4) lu

5) sa

6) au

7) pa

8) ĵi

	A	AV	AVT	G
9) sI				
10) pi				
11) di				
12) du				
13) ti				
14) nu				
15) cu				
16) na				
17) ma				
18) nu				
19) ra				
20) sa				
21) si				
22) ba				
23) ta				
24) pu				
25) ju				
26) ci				
27) ja				
28) bi				
29) da				
30) la				
31) na				
32) vi				

	A	AV	AVT	G
33) ɖa				
34) gi				
35) ɖu				
36) ti				
37) ʃi				
38) bu				
39) ga				
40) lu				
41) ʃu				
42) li				
43) tu				
44) gu				
45) mi				
46) ka				
47) ɭa				
48) pu				
49) sa				
50) ku				
51) yu				
52) wu				
53) ya				
54) di				
55) wa				
56) ʃa				
57) ɖa				

	A	AV	AVT	G
58) ča				
59) ɭi				
60) yi				
61) ɳi				
62) vi				
63) šu				
64) ru				

Aspirated Consonants:

- 1) kha
- 2) pha
- 3) cha
- 4) bha
- 5) jha
- 6) dha
- 7) ɖha
- 8) gha
- 9) tha

Clusters

- 1) ppa
- 2) bba
- 3) gga
- 4) mra
- 5) bda
- 6) gla

	A	AV	AVT	G
7) mba				
8) bla				
9) stra				

11.2 Words

The subject is asked to repeat the words after the tester. The tester should present the stimulus word with only AV cues. For those words for which the error response is obtained, corresponding picture is placed in front of the child, and the child is asked to imitate the stimulus word. If the subject still produces error response and if the subject can read, the graphemic stimulus is given. The response is recorded under $\sqrt{X}$ -, comments. The responses are also tape-recorded for later transcription.

AV	+P	+G
$\sqrt{X}$ -comments	$\sqrt{X}$ -comments	$\sqrt{X}$ -comments

Monosyllabic

- 1) ba:
- 2) hu:
- 3) ta:
- 4) a:
- 5) kai

Disyllabic/Trisyllabic in speech

- 1) bassu
'bus'
- 2) kaṇṇu
'eye'

	AV	+P	+G
	√ x-comments	√ x-comments	√ x-comments
3) appa			
'father'			
4) mara			
'tree'			
5) na:yi			
'dog'			
6) pencillu			
'pencil'			
7) te:ballu			
'table'			
8) saykallu			
'bicycle'			
9) ba:gilu			
'door'			
10) kiṭaki			
'window'			
11) buguri			
'top'			
12) cappali			
'chappal'			
13) haḷadi			
'yellow'			
14) kudure			
'horse'			

AV	+P	+G
√X-comments	√X-comments	√X-comments

- 15) na:lige
'tongue'

Words of various lengths at random

- 1) ba:lehaŋŋu
'banana'

- 2) kurči
'chair'

- 3) aŋgi
'shirt'

- 4) nidde
'sleep'

- 5) chatri
'umbrella'

- 6) ĵinke
'deer'

- 7) ondu
'one'

- 8) taṭṭe
'plate'

- 9) čombu
'metal pot'

- 10) maŋca
'cot'

	AV	+P	+G
	√ X-comments	√ X-comments	√ X-comments
11) ba:čaŋige			
'comb'			
12) dra:kʃi			
'grapes'			
13) navilu			
'peacock'			
14) railu			
'rail'			

11.3. Phrases of limited lengths

The items are presented through AV and G if he fails in AV (if the subject can read). The responses are tape-recorded. Nonverbal responses made are noted.

1) ga:ʃina bale	AV
'glass bangle'	G
2) nanna ka:lu	AV
'my leg'	G
3) kempu gannu	AV
'red gun'	G
4) aɖige mane	AV
'kitchen'	G
5) innoŋdu pennu	AV
'another one pen'	G
6) hattu baraɭu	AV
'ten fingers'	G

7) čikkevanu	AV
‘younger one’	G
8) maragira	AV
‘tree, etc.’	G
9) na:yigi:yi	AV
‘dog, etc.’	G
10) nimage	AV
‘to you’	G
11) ammanna	AV
‘mother (obj.)’	G
12) ba:yalli	AV
‘in the mouth’	G
13) kaiyalli	AV
‘in the hand’	G
14) ta:bal me:le	AV
‘one the table’	G
15) basninda	AV
‘from the bus’	G
16) ammana ha:ge	AV
‘like mother’	G
17) nanaginta	AV
‘than me’	G
18) biṭre biḍu	AV
‘leave if you can’	G
19) bidre aḷutte	AV
‘weeps if falls’	G

20) eḷani:ru	AV
'tender coconut'	G
21) maḷega:la	AV
'rainy season'	G
22) ma:vina mara	AV
'mango tree'	G

11.4. Sentence types (instructions same as for phrases)

1) idu mara	AV
'this is a tree'	G
2) ra:ma barta:ne	AV
'Rama comes'	G
3) ra:dha o:dilla	AV
'Radha has not studied'	G
4) ivanu doḍḍa huḍuga	AV
'this is the elder boy'	G
5) lata tirugi u:ṭa ma:ḍṭa:le	AV
'Latha takes means again'	G
6) pa:pa a:ṭa a:ḍabahudu	AV
'baby may play'	G
7) nanage hoṭṭe hasiva:gtide	AV
'I am feeling hungry'	G
8) gouri o:didre pa:sa:gta:le	AV
'Gowri passes if (she) studies'	G

9) idakkinta a: mara doḍḍadu	AV
'that tree is bigger than this'	G

10) na:vibbaru: ho:gi avaḷannu no:ḍo:ṇa	AV
'let us both go and see her'	G

12. Comprehension test:

12.1. Lexical recognition

Body Parts	ninna _____ to:rsu/elli?
	'your _____ show/ where ?

- | | |
|------------|----------|
| 1) kannu | 'eye' |
| 2) kivi | 'ear' |
| 3) kai | 'hand' |
| 4) ka:lu | 'leg' |
| 5) mu:gu | 'nose' |
| 6) ba:yi | 'mouth' |
| 7) hallu | 'tooth' |
| 8) na:lige | 'tongue' |
| 9) uguru | 'nail' |
| 10) beraḷu | 'finger' |

Colours

- | | |
|-----------|----------|
| 1) kempu | 'red' |
| 2) hasiru | 'green' |
| 3) ni:li | 'blue' |
| 4) haḷadi | 'yellow' |
| 5) biḷi | 'white' |
| 6) kappu | 'black' |

Kinship Terms (If possible)

- | | |
|---------------|---------------------------------|
| 1) appa | 'father' |
| 2) amma | 'mother' |
| 3) akka tangi | 'elder sister younger sister' |
| 4) tamma aṇṇa | 'younger brother elder brother' |
| 5) ajja ajji | 'grand-father grand-mother' |

Common Nouns

1) ni:ru	'water'
2) nalli	'tap'
3) combu	'water pot (metal)'
4) bakeṭṭu	'bucket'
5) braṣṣu	'brush'
6) pe:sṭu	'paste'
7) so:pu	'soap'
8) ṭavelu	'towel'
9) taṭṭe	'plate'
10) lo:ṭa	'tumbler'
11) čamaca	'spoon'
12) kappu	'cup'
13) pa:tre	'vessel'
14) ča:pe	'mat'
15) laṅga/blouse/ aṅgi /ṣarṭu/ pyaṇṭu	'skirt/blouse/ shirt/shirt/ pants'
16) ba:caṇige	'comb'
17) eṇṇe	'oil'
18) te:pu	'tape'
19) te:ballu	'table'
20) kurči	'chair'
21) čappali	'slipper'
22) bya:gu	'bag'
23) pustaka	'book'
24) pensillu/pennu	'pencil/pen'
25) bassu/sku:ṭar/ saikallu	'bus/scooter/ 'cycle'

26) mane

'house'

List the other vocabulary the child has

- 1)
- 2)
- 3)
- 4)
- 5)
- 6)
- 7)

12.2. Following commands

Each item is at first presented audio-visually (AV₁). If the subject fails to respond, or gives a wrong response one repetition is allowed (AV₂). If the subject still gives a wrong response or fails to do the task, the items are presented graphemically (G.), if he can read. If the subject still does not give the correct responses, gestures (Ge.) are to be supplemented along with AV. Responses are recorded as right (✓), wrong (X), no response (-), and comments are made when necessary.

1) ba:gilu tegi
'open the door'

AV₁AV₂

G.
Ge.

2) ammana kari
'call the mother'

AV₁AV₂

G.
Ge.

3) kannu mučču
'close the eye'

AV₁AV₂

G.
Ge.

4) ba:lu esi	AV ₁
'throw the ball'	AV ₂
	G.
	Ge.
5) pustaka tago:	AV ₁
'take the book'	AV ₂
	G.
	Ge.
6) kai to:rsu	AV ₁
'show the hand'	AV ₂
	G.
	Ge.
7) ta: ta: ma:du	AV ₁
'bid good bye' (say ʔa: ʔa:)	AV ₂
	G.
	Ge.
8) eddu nintko	AV ₁
'stand up'	AV ₂
	G.
	Ge.
9) laiʔ ha:ku'	AV ₁
'switch on the light'	AV ₂
	G.
	Ge.
10) allige ho:gu	AV ₁
'go there'	AV ₂
	G.
	Ge.
11) ba:lu kodti:ya:	AV ₁
'will you give the ball?'	AV ₂
	G.
	Ge.
12) ba:lannu du:ra esi	AV ₁
'throw the ball away'	AV ₂
	G.
	Ge.

13) akkanna karedu il/illi ku:tko	AV ₁
'call the elder sister, sit here'	AV ₂
G.	
Ge.	
14) ba:gilu mučči di:pa a:rsu/a:risu	AV ₁
'having closed the door switch off the light'	AV ₂
G.	
Ge.	
15) kai toleđu, oreskonđu	
a:me:le idanna tinnu	AV ₁
'having washed the hand, having	
wiped, then eat this'	AV ₂
G.	
Ge.	

12.3. Conversation

This sub-test is to be tape-recorded. Instructions for item presentation are same as for commands. Verbal / non-verbal responses are to be indicated. Responses are marked as √, X, -, with comments, if essential.

1.1) ninna hesare:nu	AV ₁
'what is your name?'	AV ₂
G.	
Ge.	
1.2) ninna vayasseštu (ninage eštu varša)	AV ₁
'what is your age?' (how old are you?)	AV ₂
G.	
Ge.	
1.3) appana hesare:nu	AV ₁
'what is father's name?'	AV ₂
G.	
Ge.	
2.1) appa elli	AV ₁
'where is father?'	AV ₂
G.	
Ge.	

2.2) amma elli	AV ₁
'where is mother?'	AV ₂
	G.
	Ge.
3.1) ninna u:ru ya:vudu	AV ₁
'which is your (native) place?'	AV ₂
	G.
	Ge.
3.2) nimma mane elide	AV ₁
'where is your house?'	AV ₂
	G.
	Ge.
3.3) nimma mane:li ya:ru ya:ru idda:re	AV ₁
'who are all there in your house?'	AV ₂
	G.
	Ge.
3.4) nimma maneyinda illige he:ge bande	
nadkonda: basnalla:	AV ₁
'how did you come here from your house?'	
by walk? by bus?'	AV ₂
	G.
	Ge.
4.1) ni:nu sku:lige ho:gti:ya:	AV ₁
'Will you go to school?'	AV ₂
	G.
	Ge.
4.2) ya:va sku:lu	AV ₁
'Which school?'	AV ₂
	G.
	Ge.
4.3) estane: kla:su	AV ₁
'Which class?'	AV ₂
	G.
	Ge.

5.1)	ni:nu ka:lig/kaige e:nu ha:ki- kondiddk:ya: 'what have you put on your leg/hand?'	AV ₁ AV ₂ G. Ge.
5.2)	i: saratu/langa hosada: 'is this shirt/skirt a new one?'	AV ₁ AV ₂ G. Ge.
5.3)	i: cappali hale:da: 'is this slipper an old one?'	AV ₁ AV ₂ G. Ge.
6.1)	ninage sarai ista:na: 'do you like necklace?'	AV ₁ AV ₂ G. Ge.
6.2)	ninage ousadhi ista:na: 'do you like medicine?'	AV ₁ AV ₂ G. Ge.
6.3)	i: pensilu/batte ninda: 'is this pencil/cloth yours?'	AV ₁ AV ₂ G. Ge.
6.4)	i: bya:gu ninda: 'is this bas yours?'	AV ₁ AV ₂ G. Ge.
7.1)	na:nu ya:ru 'who am I?'	AV ₁ AV ₂ G. Ge.
7.2)	ivaru ya:ru 'who is this?'	AV ₁ AV ₂ G.

7.3)	idu e:nu 'what is this?'	Ge. AV ₁ AV ₂
8.1)	ni:nu a:ta a:dti:ya: 'will you play?'	G. Ge. AV ₁ AV ₂
8.2)	ya:ra ʒote a:ta a:dti:ya: 'with whom are you playing?'	G. Ge. AV ₁ AV ₂
8.3)	ya:va ya:va a:ta a:dti:ya: 'what games do you play?'	G. Ge. AV ₁ AV ₂
8.4)	ninna hattira e:ne:nu a:tada sa:ma:nu ide 'what toys do you have?'	G. Ge. AV ₁ AV ₂
8.5)	ninage ha:vu ista:na: 'do you like flowers?'	G. Ge. AV ₁ AV ₂
8.6)	hu:vugala hesaru he:lu - mallige, ʒa:ʒi 'tell me names of flowers - jasmine, ...'	G. Ge. AV ₁ AV ₂
8.7)	ni:nu ʒu:ge ho:giddi:ya: 'have you visited zoo?'	G. Ge. AV ₁ AV ₂

8.8)	pra:nigala hesaru he:lu - huli, na:yi	AV ₁	
	'tell me names of animals - tiger, dog ...	AV ₂	
	G.		
	Ge.		
9.1)	ivattu beligge e:nu tindi tinde	AV ₁	
	'what did you eat at the breakfast today morning?'	AV ₂	
	G.		
	Ge.		
9.2)	amma e:ne:nu tindi adige ma:da:re	AV ₁	
	'what tiffin and eatables does mother cook?'	AV ₂	
	G.		
	Ge.		
9.3)	ni:nu ka:fi kudi:ti:yo:, ha:lu kudi:yi:yo:	AV ₁	
	'do you drink coffee or milk?'	AV ₂	
	G.		
	Ge.		
10.1)	i:va:ga beliggeno:, ra:tri:no:	AV ₁	
	'it is day or night now?'	AV ₂	
	G.		
	Ge.		
10.2)	beligge su:rya:no:/~candra:no iro:du	AV ₁	
	'who will be there in the morning, sun or moon?'	AV ₂	
	G.		
	Ge.		
11.1)	ni:nu ellinda ellige ho:gti:ya:	AV ₁	
	'where do you from here?'	AV ₂	
	G.		
	Ge.		

11.2)	manege ho:gi e:nu ma:d̥ti:ya:	AV ₁
	'what do you do after going home'	AV ₂
	G.	
	Ge.	
11.3)	elli, ʈa: ʈa: ma:du	AV ₁
	'ey, say good bye'	AV ₂
	G.	
	Ge.	

12. Pictures to be used (indicate AV, G., Ge.)

- 1) ivaribralli ya:ru čikkavaru
'who is shorter among the two?'
- 2) idralli ya:vudu ettara
'which is taller in these'
- 3) idralli ya:vudu san̥ṇa
'which is smaller in these'
- 4) idralli ya:vudu kuḷḷu
'which is dwarfer in these'
- 5) idralli ya:vudu dappa
'which is thicker in these?'
- 6) idralli ya:vudu ettara
'which is taller in these?'

13. Prepositions (indicate AV, G., Ge.)

- 1) i: pustaka elide _____
'where is this book'
- 2) i:ga (eillide) _____
'now (where)?'
- 3) i:ga (eillide) _____
'now (where)?'

- 4) i:ga (eillide) _____
'now (where)?'
- 5) i:ga (eillide) _____
'now (where)?'
- 6) i:ga (eillide) _____
'now (where)?'
- 7) i:ga (eillide) _____
'now (where)?'

14. Fill up the blanks

Example: a) ni:ru ĵhuļu ĵhuļu anta hariyutte
'water flows (with ĵhulu ĵhulu sound)'
b) na:yi bow bow annutte
'dog barks (with bow bow sound)'

- 1) ghañte _____ anta/e:nu şabda ma:ḍutte
'bell _____ like / what sound it makes?'
- 2) maļe _____ anta/he:ge bi:lutte
'rain _____ like/how it falls?'
- 3) pustaka _____ anta / he:ge bi:lutte
'book _____ like / how it falls?'
- 4) ka:su _____ anta/he:ge bi:lutte
'coin _____ like/how it falls?'
- 5) tabala/drammu _____ anta/he:ge şabda ma:ḍutte
'tabla/drum _____ like/what sound it makes?'
- 6) geñje _____ anta/he:ge şabda ma:ḍutte
'anklet _____ like/what sound it makes?'

- 7) baṭṭe ogeyo:va:ga _____ anta/he:ge ṣabda a:gutte
'while washing _____ like/what sound comes?'
- 8) railu _____ anta/he:ge ṣabda ma:ḍutte
'train _____ like/what sound it makes?'
- 9) bassu _____ anta/hege ṣabda ma:ḍutte
'bus _____ like/what sound it makes?'
- 10) bekku _____ (e:nu) annutte
'cat _____ what sound it makes?'

15. Plurals (pictures)

Example: illi ondu mara 'here is one tree'
illi mu:ru maragaḷu 'here are three trees'

- 1) illi ondu na:yi 'here is a dog'
illi _____ 'here _____'
- 2) illi obba tamma 'here is a brother(younger)'
illi _____ 'here _____'
- 3) illi obbaḷu huḍugi 'here is a girl'
illi _____ 'here _____'
- 4) illi obba huḍuga 'here is a boy'
illi _____ 'here _____'
- 5) illi ondu hu:vu 'here is a flower'
illi _____ 'here _____'
-

12.4. Elicitation on a topic

- 1) ninage kate he:ḷakke barutta:
'can you tell a story'

ya:va ya:va kate barutte
'what stories can you tell?'

ondu kate he:lu
'tell one story'

kate hesare:nu
'what is the name of the story?'

2) ni:nu beḷiggeyinda ra:tri tanaka e:ne:n
ma:ḍti:ya anta he:ḷiti:ya:
'what do you do from morning till evening? can
you tell'

3) nimma sku:lnalli e:ne:n pa:ṭha he:ḷkoḍta:re
_____ viṣaya he:lu
'what subjects do they teach you at school?
_____ tell subjects

4) ni:nu sinema:ge ho:gti:ya:
'do you go to cinema (movie)?'

ya:va sinema:ge ho:gidde
'to which cinema (movie) you had gone?
_____ sinema: kathe he:lu
'tell the story of the cinema'

5) ni:nu rajadall u:rige ho:gti:ya:
'do you go to your native town in the vacation?'

ya:vu:rige
'to which town?'

alli ya:ridda:re
'who is there?'

a: u:rnalli e:ne:nide
'what are there in that town?'

a: u:rnalli e:ne:n ma:ḍti:ya:
'what do you do in that town?'

- 6) Or use a picture story (or action picture) to elicit speech

Transcription of what is narrated by the subject

Voice

Pitch -

Loudness -

Quality -

Other aspects of speech of the child (General remarks)

Rate of speech -

Intelligibility -

Rhythm -

Intonation -

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